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ABSTRACT

This task list of workplace skills for collision repair and refinish technicians resulted from grant from the U.S. Department of Education to the National Automotive Technician Education Foundation (NATEF) of the National Institute for Automotive Service Excellence. The skills list is integrated with academic skills. This document lists the following 13 workplace skills, each with subskills: developing an employment plan; seeking and applying for employment opportunities; accepting employment; communicating on the job; interpreting the economics of work; maintaining professionalism; adapting/coping with change; solving problems and critical thinking; maintaining safe and healthy environment; demonstrating work ethics and behavior; demonstrating technology literacy; maintaining interpersonal relationships; and demonstrating team work. The list is followed by four sections that provide the following: (1) a narrative for language arts-related academic skills for the NATEF collision repair and refinish technician task lists; (2) a matrix showing how the language arts skills relate to the NATEF technical skills for collision repair and refinish and definitions of these applications; (3) a list of the language arts/communication skills integrated into the structural analysis and damage repair skills; and (4) the NATEF task list listing the technical skills for collision repair and refinish occupations. (KC)

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# APPLIED ACADEMIC &
# WORKPLACE SKILLS
# FOR
# COLLISION REPAIR & REFINISH TECHNICIANS

YOUR KEY TO THE FUTURE
ASE CERTIFIED
NATEF
NATIONAL
AUTOMOTIVE TECHNICIANS
EDUCATION FOUNDATION, INC.

National Automotive Technicians Education Foundation (NATEF)
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# PREFACE

This work represents a joint effort by the National Automotive Technicians Education Foundation (NATEF) and the Vocational-Technical Education Consortium of States (V-TECS). The examples that are given represent one of many applications of the academic skills. We sincerely hope that they will assist your efforts to apply this research to your own particular needs.

A very special thanks to all the technicians who participated in the workshops and provided the technical expertise to our research effort.

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# INTRODUCTION

## By V-TECS

### Background

The National Automotive Technician Education Foundation (NATEF) of the National Institute for Automotive Service Excellence (ASE) was one of the recipients of a Department of Education grant for the development of business and industry skill standards for the occupations of Automobile Technician, Autobody Technician (now Collision Repair and Refinish), and Medium/Heavy Truck Technician. Since NATEF had already developed Duty/Task Lists and Equipment Lists for these three areas, they proposed to spend their resources on the re-validation of these task lists as well as the identification of the Related Academic Skills embedded in the Automobile, Collision Repair and Refinish and Medium/Heavy Truck Task Lists.

Rather than do this work in-house, NATEF chose to contract with the Vocational-Technical Education Consortium of States (V-TECS), Southern Association of Colleges and Schools to conduct the analysis. V-TECS was chosen because of its twenty-year history in occupational and task analysis as well as its recent success in using a taxonomy to identify related academic and workplace skills within and across occupations.

### Process Used to Identify the Related Academic Skills Embedded in the NATEF Task List for the Collision Repair and Refinish Technician

V-TECS began the process of identifying the related academic skills by meeting with Dr. Patricia Lundquist, NATEF Executive Director, to outline the strategy for conducting the project. It was decided early on that NATEF would identify two different sites around the country where a high concentration of ASE Certified technicians lived and worked. Once these sites were identified, Dr. Lundquist then worked with local teachers and contacts in the autobody industry to identify the names of outstanding ASE Certified technicians in the surrounding area. These names, along with a useable address, was given to V-TECS who contacted the technicians and asked if they would participate in a two-day meeting designed to identify the skills. Technicians were offered a small honorarium to offset the pay they would lose by participating in the meeting. This entire project was carried out with the highest level of teamwork between ASE/NATEF and V-TECS and could be described as a perfect partnership in that Dr. Lundquist identified the technicians and V-TECS handled the logistics and conducted the meetings on site along with Dr. Lundquist.

Since five specialty areas existed within the NATEF Collision Repair and Refinish Task List, the decision was made to treat the total collision repair and refinish technician task list as follows:

## MEETING SITES AND SPECIALTIES ADDRESSED

| Meeting No. | Location | Specialties |
|---|---|---|
| 1 | Fort Lauderdale, Florida | • Structural Analysis and Damage Repair<br>• Non-Structural Analysis and Damage Repair |
| 2 | Pittsburgh, Pennsylvania | • Mechanical and Electrical Components<br>• Plastic Repair<br>• Painting and Refinishing |

## TECHNICIANS WHO PARTICIPATED IN EACH MEETING

| Meeting Location | Participants | |
|---|---|---|
| Fort Lauderdale, Florida | Mr. Ridel Gomez<br>Airport Body Shop<br>3020 South Federal Highway<br>Ft. Lauderdale, FL 33316 | Mr. Mike Setzer<br>Instructor, Sheridan Vo-Tech<br>5400 Sheridan Street<br>Hollywood, FL 33021 |
| | Mr. Steve Wood<br>Body Shop Manager<br>Ft. Lauderdale Nissan<br>122 Southwest 22nd Street<br>Ft. Lauderdale, FL 33316 | |

| Meeting Location | Participants | |
|---|---|---|
| Pittsburgh,<br>Pennsylvania | Mr. Dennis Moffa<br>Body Shop Manager<br>Ted McWilliams Toyota City<br>3475 William Penn Highway<br>Pittsburgh, PA 15235<br><br>Mr. Johnny R. Mock<br>Johnny Mock's CARSTAR<br>1271 Rodi Road<br>Turtle Creek, PA 15145<br><br>Mr. Dan Frohlich<br>ARS Automotive<br>405 Davidson Road<br>Pittsburgh, PA 15239<br><br>Mr. Fran Roberts<br>Roberts CARSTAR Auto Body<br>P. O. Box 503<br>Fayette City, PA 15438<br><br>Mr. John Warabow<br>101 Colonial Way<br>Cannonsburg, PA 15317 | Mr. John Opeka<br>440 Valley Brook Road<br>McMurry, PA 15317<br><br>Mr. Ed Gibson<br>Gibson CARSTAR Body Works<br>243 East Main Street<br>Monongahela, PA 15063<br><br>Mr. Dale Williams<br>Rt. 2, Box 145, 11 A<br>Saltsburg, PA 15681<br><br>Mr. Ralph Paga<br>1492 Maple Avenue<br>Glenshaw, PA 15116<br><br>Mr. Pete Kozak<br>660 Linden Avenue<br>Johnstown, PA 15902<br><br>Mr. Joe Masollo<br>2418 Wolford Street<br>Pittsburgh, PA 15226 |

The same basic procedure was followed in each site. The meetings began with an explanation of the project by Dr. Patricia Lundquist followed by an overview of V-TECS and the process to be used by Dr. Ronald D. McCage, Executive Director of V-TECS. The technicians were then introduced to the overall structure of the Snyder Basic/Essential Skills Taxonomy by Dr. McCage, who led the analysis process for the two collision repair and refinish technician meetings. During this part of the process, Dr. McCage systematically brought the technicians into the process so that they would become comfortable with it. The technicians were told that they were considered to be the experts and that their role was to tell the team when a language arts, math, or science concept was used in their field. To help them understand the specific definitions of the concepts, V-TECS used three academic experts for each of the four meetings. These experts were: Ms. Barbara Blasch, Mathematics; Dr. Chrysandra Spiceland, Language Arts; and Dr. Trina Boteler, Science. The process involved taking each of the tasks in each of the five NATEF specialty areas and asking the technicians to identify the language arts, math and science skills needed to perform each task. Their responses were recorded using the Snyder Taxonomy codes and then put into a data base. At the end of the meetings each technician was also asked to rate each item on a list of Workplace Skills regarding their importance to their occupational specialty of Collision Repair and Refinish.

Once all of the meetings had been conducted, a composite or unduplicated list of the related academic codes was assembled for language arts, math, and science along with a table representing the most important workplace skill statements identified. Specific statements were then written for each of the codes with an emphasis on how the skill was used in the occupation. After this was accomplished, a more generic list was developed for the general public as well as a transformation of the comprehensive coded list into the five specialty lists that were specific to each of the five areas. A matrix was then built showing the relationship between the composite list and each of the five sublists. Several crosschecks and reviews were made to insure the accuracy of the statement as well as its relationship to each of the areas. The task by task analysis data and the Workplace Skills data was also provided to NATEF as documentation for the process. For a clearer understanding of these various lists, the following items represent an entry for each skill category for the Collision Repair and Refinish technician occupation.

LA001 Adapts Diction/Structure
- The technician adapts diction and structure to the context of all verbal and written communication, based on the audience, purpose, and specific situation.

MA001 Calculates/Evaluates Algebraic Expressions
- The technician can identify when to use Ohm's Law to determine circuit parameters that are out-of-tolerance.

SC007 Analyzes/Evaluates Environmental Issues
- The technician uses government impact statements, media information, and general knowledge of pollution and waste management to correctly use and dispose of waste products.

The following pages contain this information in a variety of formats as identified within the specific areas.

# WORKPLACE SKILLS

IDENTIFIED AS BEING IMPORTANT BY THE NATEF
COLLISION REPAIR AND REFINISH TECHNICIANS
RELATED ACADEMIC SKILLS COMMITTEE
FROM THE V-TECS/ILLINOIS WORKPLACE SKILLS LIST

## A. DEVELOPING AN EMPLOYMENT PLAN

1. Match aptitudes and interest to employment area.
2. Match attitudes to a job area.
3. Match personality type to job area.
4. Match physical capabilities to a job area.
5. Demonstrate a drug-free status.

## B. SEEKING AND APPLYING FOR EMPLOYMENT OPPORTUNITIES

1. Locate employment opportunities.
2. Identify job requirements.
3. Locate resources for finding employment.
4. Prepare a resume.
5. Identify conditions for employment.
6. Evaluate job opportunities.
7. Identify steps in applying for a job.
8. Complete job application form.
9. Identify attire for job interview.

## C. ACCEPTING EMPLOYMENT

1. Apply for social security number.
2. Complete state and federal tax forms.
3. Accept or reject employment offer.
3. Complete employees withholding allowance certificate Form W-4.

## D. COMMUNICATING ON THE JOB

1. Communicate orally with others.
2. Use telephone etiquette.
3. Prepare written communication.
4. Follow written directions.
5. Ask questions about task.

## E. INTERPRETING THE ECONOMICS OF WORK

1. Describe responsibilities of employee.
2. Describe responsibilities of employer or management.
3. Investigate opportunities and options for business ownership.
4. Assess entrepreneurship skills.

## F. MAINTAINING PROFESSIONALISM

1. Assess business image and products/services.
2. Identify positive behavior.
3. Identify company dress and appearance standards.
4. Participate in meetings.
5. Identify work-related terminology.
6. Identify how to treat people with respect.

## G. ADAPTING/COPING WITH CHANGE

1. Identify the elements of the job transition.
2. Formulate transition plan.
3. Exhibit ability to handle stress.
4. Recognize need to change or quit a job.
5. Write a letter of resignation.

## H. SOLVING PROBLEMS AND CRITICAL THINKING

1. Identify the problem.
2. Clarify purposes and goals.
3. Identify solutions to the problem and their impact.
4. Employ reasoning skills.
5. Evaluate options.
6. Set priorities.
7. Select and implement a solution to a problem.
8. Evaluate results of implemented options.
9. Organize workloads.
10. Access employer and employee responsibility in solving a problem.

## I. MAINTAINING SAFE AND HEALTHY ENVIRONMENT

1. Identify safety and health rules/procedures.
2. Demonstrate the knowledge of equipment in the work place.
3. Identify conservation and environmental practices and policies.
4. Act during emergencies.
5. Maintain work area.
6. Identify hazardous substances in the work place.

## J. DEMONSTRATING WORK ETHICS AND BEHAVIOR

1. Identify established rules, regulations and policies.
2. Practice cost effectiveness.
3. Practice time management.
4. Assume responsibility for decisions and actions.
5. Exhibit pride.
6. Display initiative.
7. Demonstrate willingness to learn.
8. Identify the value of maintaining regular attendance.
9. Apply ethical reasoning.

## K. DEMONSTRATING TECHNOLOGY LITERACY

1. Demonstrate basic keyboarding skills.
2. Demonstrate basic knowledge of computing.
3. Recognize impact of technological changes on tasks and people.

## L. MAINTAINING INTERPERSONAL RELATIONSHIPS

1. Value individual diversity.
2. Respond to praise or criticism.
3. Provide constructive praise or criticism.
4. Channel and control emotional reactions.
5. Resolve conflicts.
6. Display a positive attitude.

## M. DEMONSTRATING TEAM WORK

1. Identify style of leadership used in team work.
2. Match team member's skills and group activity.
3. Work with team members.
4. Complete a team task.
5. Evaluate outcomes.

## NARRATIVE FOR LANGUAGE ARTS RELATED ACADEMIC SKILLS
## for all
## NATEF Collision Repair and Refinish Technician Task Lists

The collision repair and refinish technician must be proficient in the following Language Arts and Communications Related Academic Skills that are embedded in the occupation. Using these skills the technician must be able to:

- Request, collect, comprehend, evaluate, and apply oral and written information gathered from customers, associates, and supervisors regarding problem symptoms and potential solutions to problems.

- Identify the purpose for all written and oral communication and then choose the most effective strategies for listening, reading, speaking, and writing to facilitate the communication process.

- Adapt a reading strategy for all written materials, e.g. customer's notes, service manuals, shop manuals, technical bulletins, etc., relevant to problem identification, diagnosis, solution, and repair.

- Attend to verbal and nonverbal cues in discussions with customers, supervisors, and associates to verify, identify, and solve problems.

- Use study habits and techniques, i.e. previewing, scanning, skimming, taking notes, etc., when reviewing publications (shop manuals, references, databases, operator's manuals, and text resources) for problem solving, diagnosis, and repair.

- Use prior knowledge learned from solving similar problems to diagnose and repair specific problems.

- Write clear, concise, complete, and grammatically accurate sentences and paragraphs.

- Write warranty reports and work orders to include information regarding problem resolution and the results of the work performed for the customer or manufacturer.

- Comprehend and apply industry definitions and specifications to diagnose and solve problems in all systems and components of the automobile and light truck.

- Follow all oral/written directions that relate to the task or system under study.

- Comprehend and use problem-solving techniques and decision trees that are contained in service manuals and databases to determine cause-and-effect relationships.

- Scan service manuals and databases to locate specific information for problem-solving purposes.

- Use the service manual to identify the manufacturer's specifications for system parameters, operations, and potential malfunctions.

- Interpret charts, tables, or graphs to determine the manufacturer's specifications for systems operation to identify out-of-tolerance systems and subsystems.
- Supply clarifying information to customers, associates, parts suppliers, and supervisors.

## NARRATIVE FOR MATHEMATICS RELATED ACADEMIC SKILLS
## for all
## NATEF Collision Repair and Refinish Technician Task Lists

The collision repair and refinish technician must be proficient in the following Mathematics-Related Academic Skills that are embedded in the occupation. Given these skills the technician must be able to:

- Determine the proper sequence of arithmetic operations that are needed to arrive at a solution that can be compared to other specifications when comparing system measurements or tolerances to the manufacturer's specifications.
- Add two or more whole numbers, fractions, or decimals to determine component conformance of multiple measurements with the manufacturer's specifications.
- Subtract whole numbers, fractions, or decimals to arrive at a difference for comparison with the manufacturer's specifications.
- Multiply whole numbers, fractions, or decimals to arrive at a solution for comparison with the manufacturer's specifications.
- Divide decimals to determine measurement conformance with the manufacturer's specifications.
- Convert variables presented orally to a mathematical form that allows for an algebraic solution.
- Estimate the results of basic arithmetic operations, and accurately round up or down depending on the appropriate rule for the situation.
- Analyze and solve problems requiring the use of fractions, decimals, ratios, or percentages by a direct or indirect variation of the numerical elements of the problem.
- Determine the irrelevant and/or missing data needed to solve a problem.
- Determine and interpret place value (tenths, hundredths, thousandths) when conducting precision measurements.
- Use Centigrade or Fahrenheit measurement scales to determine the existing temperature of substances such as a coolant, lubricant, compound, or finish material.
- Use English and metric volume measurement techniques to determine the volume of a system, component, or cylinder.
- Use conventional symbols (E for voltage, etc.) to solve circuit parameter calculations using formulas such as Ohm's Law, E=IR.
- Understand that if the described problem has certain conditions (symptoms), then a limited number of solutions to the problem apply.

- Understand the relationship between the frequency of the occurrence of a problem (symptom) and the probability of accurately predicting the problem.

- Calculate the average (mean) of several measurements to determine the variance from the manufacturer's specifications.

- Use English and metric angle and distance measurements and techniques to determine parallel lines, perpendicular lines, and angle variances from the manufacturer's specifications.

- Solve problems that involve determining the relative proportion of the desired versus undesired ingredients or elements of a mixture, and determine if that proportion is within the manufacturer's specifications.

- Comprehend and use standards defined by each manufacturer for the component or system being analyzed and repaired.

- Convert test readings that are in decimal or fraction form to a ratio or percent for comparison with the manufacturer's specifications for the sub-system under review.

- Know when to use an estimated performance value versus an exact value, basing the decision on the system being analyzed or repaired.

- Visually perceive the geometric relationship of systems and sub-systems that require alignment.

- Construct or interpret a chart, table, graph, or symbol that depicts a range of performance characteristics that can be used for comparing various system operational conditions.

- Use measurement devices to determine the parallelism or perpendicularity of chassis, suspension, and other vehicle components requiring geometric alignment.

- Use formulas to indirectly confirm that systems are outside of the manufacturer's specifications.

- Verify that the relationship between parallel lines and angles concurs with the manufacturer's specifications when diagnosing a system's malfunction.

- Formulate an angle visually and verify conformance to the manufacturer's specified angle.

- Measure timed or sequenced parameters to determine conformance with the manufacturer's specifications.

- Use English and metric scales to determine the conformance of components to the manufacturer's specified weight.

- Determine the degree of conformance to the manufacturer's specifications for length, volume, and other appropriate measurements in the English and/or metric system.

- Distinguish the congruence of the measured tolerances with those specified by the manufacturer.
- Measure and/or test with tools designed for English or metric measurements, then convert the result to the manufacturer's system used for specifying the correct measurement or tolerance.
- Compute mentally whether the observed measurement is out-of-tolerance when comparing the observed measurement to the manufacturer's specifications.
- Solve problems that involve determining whether the proportion of the existing volume or mixture compares to the manufacturer's specifications and is within the recommended tolerance.
- Distinguish whether a measurement or tolerance is equal or not equal to the manufacturer's specifications.

## NARRATIVE FOR SCIENCE RELATED ACADEMIC SKILLS
## for all
## NATEF Collision Repair and Refinish Technician Task Lists

The collision repair and refinish technician must be proficient in the following Science-Related Academic Skills that are imbedded in the occupation. Using these skills the technician must be able to:

- Analyze and evaluate waste products from the repair task and dispose of the parts, residue, or trash according to applicable federal, state, and local rules and regulations.

- Follow all safety regulations and procedures while performing any task.

- Use the information provided in service manuals, charts, tables, graphs, or databases to determine the manufacturer's specifications for system(s) operation(s) and the appropriate repair/replacement part and/or procedure.

- Develop a hypothesis regarding the cause of the problem and test the hypothesis to determine the solution to the problem.
    1. identify the problem
    2. gather information
    3. develop hypothesis
    4. take action
    5. check results

- Convert measurements taken using the English or metric system to specifications stated in terms of either system.

- Demonstrate an understanding of the chemical reaction that occurs in various compounds and substances used in the automobile.

- Explain the role an additive or catalyst plays in the mixing of fillers or finishes for use on the automobile body.

- Describe and explain the role that pigmentation plays in determining the specific shade of an automobile body or interior component color.

- Demonstrate an understanding of the total color spectrum by explaining the roles different colors play in different mixtures and finishes.

- Explain how various forms of energy are dissipated throughout the body based on the momentum of the vehicle at the time of impact.

- Explain the principles of force as it applies to the realignment of components.

- Demonstrate an understanding of the role of balanced and unbalanced forces on linear or rotating vehicle assemblies.

- Explain how the velocity of an object in motion impacts on another object.

- Explain how the rate of a force in motion can impact on an automobile body.
- Demonstrate an understanding of the concept of pressure in relation to the concept of using force to realign a component.
- Explain the concept of heat transfer in terms of conduction, convection, and radiation in various automotive systems.
- Demonstrate an understanding of the expansion and contraction of system parts as a result of heat generated during use and the cooling down of the system when not in operation.
- Demonstrate an understanding of the effect that adding heat will cause in a state of matter, such as changing a solid to a liquid to a gas.
- Explain the role of insulation in maintaining stable temperatures or preventing the transfer of heat to an unwanted area.
- Explain the difference between heat and temperature and demonstrate an understanding of how to measure each in different situations.
- Explain how the angle or amount of light can impact on the appearance of a given finish in terms of texture and quality of finish.
- Explain color and shades of color based on how light hits or passes through it.
- Explain the difference between the principles of translucent light (diffuses) as contrasted to transparent light (passes through).
- Explain how ultraviolet rays can cause a finish or substance to deteriorate.
- Demonstrate an understanding of refraction in fiber optic systems.
- Explain that dyes added to fluids fluoresce under ultraviolet light and provide a process for determining the source of leakage in a system.
- Explain in detail the three states of matter.
- Explain to a customer how sound can be amplified due to resonant cavities and other physical characteristics of the vehicle.
- Explain and demonstrate an understanding of how sound generated in one place in the body and engine can be carried to other parts of the engine through metal and other materials.
- Explain the need for sound deadening and vibration damping materials to control the level of sound in the passenger compartment.

- Demonstrate an understanding of the relationship of perceived intensity to decibel level of a noise.
- Demonstrate an understanding of the types of vibrations caused by out-of-balance or excessively worn systems.
- Explain and demonstrate an understanding of the role of listening to sounds as part of the trouble-shooting process.
- Explain that the presence of overtones may indicate changes in the vibrations of various systems.
- Demonstrate an understanding of and discuss relative humidity in terms of effect on paint and substance applications.
- Explain how levers and pulleys can be used to increase an applied force or distance.
- Identify the effect of the pH of a solution on chemical changes in a system.
- Identify the characteristics that define a component or system that is operating within the manufacturer's specifications.
- Use precision measuring devices to determine if replaced components are within the manufacturer's specifications, and to assure that repair or replacement parts meet the manufacturer's specifications.
- Use tension gauges, such as a torque wrench, to measure the force or tension required to tighten connections to the manufacturer's specifications.
- Use a scale to measure component weight in order to mix an adhesive or to determine the strength and integrity of a component or part.
- Use pressure measuring tools to determine pressures in hydraulic or pneumatic paint systems and compare to the manufacturer's specifications.
- Use direct and indirect methods to measure system temperatures and then convert to Fahrenheit/Centigrade as required for proper cure and application times.
- Use direct and indirect methods to measure application times and compare the results to the manufacturer's specifications.
- Use direct and indirect methods to measure the volume of liquids in a mixture or compound.
- Use computer databases for information retrieval and input devices to process information for customers, billing purposes, warranty work, and other record-keeping purposes.

- Explain how an applied force at one location can be transmitted via fluid pressure to provide a force at a remote location.
- Explain to the customer the need for lubrication of adjacent parts to minimize friction as a result of movement at the junction of the parts.
- Explain the criticality of metals with different hardness, depending on the function and location of the metal as well as how fillers and finishes adhere to metal.
- Explain the necessity of knowing that the hardness of a metal determines, in part, its function and location in the automobile.
- Explain the dynamic control properties of a hydraulic system.
- Explain the surface processes that occur on system seals due to the absorption of the contained materials.
- Demonstrate an understanding of how torque relates to force and angular acceleration.
- Demonstrate an understanding of how cams, pulleys, and levers are used to multiply force or transfer directions of force.
- Explain how rotational motion is changed to linear motion and the need for balance in rotating systems.
- Demonstrate an understanding of how variances in flow rate will effect operation of pneumatic tools and equipment.
- Explain the dynamic control properties of a hydraulic system in terms of its impact on spray patterns, volume, etc.
- Explain the surface process that occurs on system seals due to absorption of the contained materials.
- Demonstrate an understanding of how a contaminated liquid can cause a chemical reaction which can result in the deterioration of the finish or a plastic component.
- Use precision gauges or instruments to measure the flow rate of air in a painting application.
- Demonstrate an understanding of how variances in flow rate can effect the spray patters, thickness of coat, etc., in the finishing process.
- Correctly use proportions and ratios in mixing fillers, finishes, and other substances.
- Explain the role that acids and bases have in altering compounds used on or in the automobile.

- Understand the use and safety requirements of all solvents used in an automotive application.
- Demonstrate an understanding of how surface processes and cohesive/adhesive forces aid in glues, tapes, and sealants.
- Identify the physical properties of an automobile component or system that are made of glass or plastic.
- Describe or explain the role that activators have in causing a change in the chemical state of a compound or filler.
- Explain fluid viscosity as a measurement and why it is important to the application of fillers, plastics, and finishes.
- Locate and explain the properties of a given source of light.

**Electrical/Tolerances**

- Explain and demonstrate an understanding of the properties of electricity that impact the lighting, engine management, and other electrical systems in the vehicle.
- Demonstrate an understanding of the characteristics of a quality electrical ground and explain the problems associated with an inadequate electrical circuit ground.
- Explain voltage and current flow in series and parallel circuits.
- Demonstrate an understanding of the processes used to locate a short circuit in the electrical/electronic system.
- Demonstrate an understanding of the role of the alternator in maintaining battery and system voltage.
- Demonstrate an understanding of the role of solar panels in maintaining battery voltage and operating selected accessories.
- Explain and demonstrate an understanding of the ignition coil's role in generating the high voltages required to fire the sparkplug.
- Demonstrate an understanding of the correct procedure used to measure the electrical parameters of voltage, current, resistance, or power.
- Explain and demonstrate an understanding of the role of a fuse or fusible link as a protective device in an electrical or electronic circuit.

- Explain and demonstrate an understanding of the use of Ohm's Law in verifying circuit parameters (resistance, voltage, amperage).
- Explain and demonstrate an understanding of the relationship of resistance to heat, voltage drop, and circuit parameters.
- Explain and demonstrate an understanding of system voltage generation, uses, and characteristics.
- Demonstrate an understanding of the ion transfer process that occurs in an automotive battery.
- Explain the effect of oxidation on electrical connections as well as on an automotive finish.
- Explain the effect of magnetic fields on unshielded circuits and voltages induced in other circuits by the magnetic fields.
- Explain how attaching magnets to an automobile body can cause paint to be evenly distributed through the principles of magnetism.
- Explain the conductivity problems in a circuit when connectors corrode due to electrochemical reactions.
- Explain the relationship between electrical current in a conductor and the magnetic field produced in a coil such as the starter solenoid.
- Explain the ability of a coil to increase battery voltage to the level required to fire a sparkplug.
- Explain the effect of magnetic fields on unshielded circuits in selected control modules.
- Explain the need for a specific gravity test of battery electrolyte to determine charge.
- Use precision electrical test equipment to measure current, voltage, resistance, continuity, and/or power.
- Demonstrate an understanding of the role of capacitance in timer circuits, such as RC timers or MAP sensors, where the changing manifold pressure causes two metal discs to act like a capacitor by sending varying voltage to the electronic engine control system.
- Demonstrate an understanding of the capacity of semiconductor devices to modify rapidly engine operation parameters depending on multiple inputs from engine operational sensors..
- Explain how the movement of a conductor in a magnetic field can generate electricity.

- Demonstrate an understanding of the role of mechanical transducers in sending electrical control signals to modify system operating characteristics.
- Demonstrate an understanding of the purpose of photocells and measurement processes relative to determining output.

## RELATED ACADEMIC SKILLS CROSSWALK FOR THE LANGUAGE ARTS/COMMUNICATIONS SKILLS EMBEDDED IN THE FIVE NATEF COLLISION REPAIR AND REFINISH TECHNICIAN SPECIALTY AREAS

| COLLISION REPAIR AND REFINISH TECHNICIAN COMPOSITE LIST<br>RAS CODE | DESCRIPTION | I. Structural Analysis and Damage Repair | II. Non-Structural Analysis and Damage Repair | III. Mechanical and Electrical Components | IV. Plastic Repair | V. Painting and Refinishing |
|---|---|---|---|---|---|---|
| LA001 | Adapts Diction/Structure | • | • | • | • | • |
| LA005 | Adapts Strategy Listening | • | • | • | • | • |
| LA006 | Adapts Strategy Reading | • | • | • | • | • |
| LA007 | Adapts Strategy Speaking | • | • | • | • | • |
| LA008 | Adapts Strategy Writing | • | • | • | • | • |
| LA009 | Adapts Style Purpose | • | • | • | • | • |
| LA013 | Applies/Uses Definitions | • | • | • | • | • |
| LA020 | Applies/Uses Study Habits/Methods | • | • | • | • | • |
| LA022 | Applies/Uses Study Habits/Methods Prior Knowledge | • | • | • | • | • |
| LA023 | Applies/Uses Study Habits/Methods Skimming/Scanning | • | • | • | • | • |
| LA035 | Attends Directions/Task | • | • | • | • | • |
| LA036 | Attends Nonverbal Cues | • | • | • | • | • |
| LA037 | Attends Verbal Cues | • | • | • | • | • |
| LA038 | Collects/Organizes Information-Oral/Written | • | • | • | • | • |
| LA069 | Composes/Edits Notes | • | • | • | • | • |
| LA074 | Composes/Edits Paragraphs | • | • | • | • | • |
| LA098 | Composes/Edits Reports Summaries | • | • | • | • | • |
| LA099 | Composes/Edits Sentences | • | • | • | • | • |
| LA121 | Comprehends Information-Oral | • | • | • | • | • |
| LA132 | Comprehends Information-Written | • | • | • | • | • |
| LA134 | Comprehends Information-Written Cause/Effect Relationships | • | • | • | • | • |
| LA136 | Comprehends Information-Written Charts/Tables/Graphs | • | • | • | • | • |
| LA147 | Comprehends Information-Written Sequence | • | • | • | • | • |
| LA167 | Evaluates Information-Oral | • | • | • | • | • |
| LA180 | Evaluates Information-Written | • | • | • | • | • |
| LA215 | Identifies Information-Written Abbreviations/Acronyms | • | • | • | • | • |

## RELATED ACADEMIC SKILLS CROSSWALK FOR THE LANGUAGE ARTS/COMMUNICATIONS SKILLS EMBEDDED IN THE FIVE NATEF COLLISION REPAIR AND REFINISH TECHNICIAN SPECIALTY AREAS

| COLLISION REPAIR AND REFINISH TECHNICIAN COMPOSITE LIST<br>RAS CODE | DESCRIPTION | I. Structural Analysis and Damage Repair | II. Non-Structural Analysis and Damage Repair | III. Mechanical and Electrical Components | IV. Plastic Repair | V. Painting and Refinishing |
|---|---|---|---|---|---|---|
| LA231 | Identifies Purpose/Strategy Listening/Reading/Speaking/Writing | • | • | • | • | • |
| LA236 | Infers/Predicts Information-Oral | • | • | • | • | • |
| LA247 | Infers/Predicts Information-Written | • | • | • | • | • |
| LA266 | Presents Informal Speech Information Requests | • | • | • | • | • |
| LA267 | Presents Informal Speech Information Supplying | • | • | • | • | • |
| LA271 | Uses Dictionary | • | • | • | • | • |
| LA278 | Uses Text Resources | • | • | • | • | • |
| LA283 | Uses Media Resources Databases | • | • | • | • | • |
| LA285 | Comprehends Information-Written Operator's Manual | • | • | • | • | • |
| LA286 | Uses Text Resources Service (Shop) Manual | • | • | • | • | • |

## Language Arts/Communications Related Academic Skills for the NATEF Collision Repair and Refinish Technician Task List

LA001 Adapts Diction/Structure
- The technician adapts diction and structure to the context of all verbal and written communication based on the audience, purpose, and specific situation.

LA005 Adapts Strategy Listening
- The technician adapts a listening strategy that will provide the information required for solving the problem.

LA006 Adapts Strategy Reading
- The technician adapts a reading strategy for all written materials, e.g. customer's notes, service manuals, shop manuals, technical bulletins, and computer/data feed readouts, etc., that will help identify the solution to the problem.

LA007 Adapts Strategy Speaking
- The technician adapts a communication strategy for the customer, supervisor, and fellow employees that will yield the highest quality usable information for problem solving.

LA008 Adapts Strategy Writing
- The technician adapts a writing strategy that is most appropriate for the intended audience (e.g. customers, supervisor, and fellow employees) when documenting repair information.

LA009 Adapts Style Purpose
- The technician adapts a style for speaking and writing that is consistent with the purpose of the communication format.

LA013 Applies/Uses Definitions
- The technician can apply industry definitions to solve problems in various components and systems of the automobile.

LA020 Applies/Uses Study Habits/Methods
- The technician uses study habits and methods when consulting the manufacturer's publications, e.g. shop manuals, references, and computer databases.

LA022 Applies/Uses Study Habits/Methods Prior Knowledge
- The technician uses prior knowledge of similar situations to determine the specific cause(s) of the problem.

LA023 Applies/Uses Study Habits/Methods Skimming/Scanning
- The technician will visually skim or scan the manufacturer's service manuals or databases to identify information that is related to any unfamiliar system under review, then study the applicable information with the intensity necessary for the situation.

LA035 Attends Directions/Task
- The technician attends to all written and oral directions that relate to the task or system under study.

LA036 Attends Nonverbal Cues
- The technician attends to nonverbal cues in discussions with customers and associates to verify, identify, and solve problems.

LA037 Attends Verbal Cues
- The technician attends to verbal cues in discussions with customers and associates to verify, identify, and solve problems.

LA038 Collects/Organizes Information-Oral/Written
- The technician collects and organizes oral and written information based on discussions, notes, observations, personal experiences, and data collection that will assist in the problem analysis and solution process.

LA069 Composes/Edits Notes
- The technician makes notes regarding symptoms, possible causes of problems, and other data that will aid in the diagnosis and problem solving process.

LA074 Composes/Edits Paragraphs
- The technician composes complete and accurate paragraphs that include information regarding symptoms, diagnosis results, and appropriate details when preparing warranty claims and information for inclusion on work orders.

LA098 Composes/Edits Reports Summaries
- The technician uses appropriate grammar and sentence structure when summarizing problems and actions taken in reports.

LA099 Composes/Edits Sentences
- The technician uses conventional sentence structure, spelling, capitalization, and punctuation when composing sentences for warranty reports.

LA121 Comprehends Information-Oral
- The technician can comprehend information gathered during discussions with customers, supervisors, and associates regarding problem symptoms and potential solutions.

LA132 Comprehends Information-Written
- The technician can comprehend and apply available written information needed to diagnose, analyze, and solve problems.

LA134 Comprehends Information-Written Cause/Effect Relationships
- The technician comprehends and uses cause and effect relationships presented in service manual problem solving trees to diagnose faults in a component or system.

LA136 Comprehends Information-Written Charts/Tables/Graphs
- The technician consults charts, tables, or graphs to determine the manufacturer's specifications for component or system alignment.

LA147 Comprehends Information-Written Sequence
- The technician consults written information to determine the applicable technical sequence required for solving a specific problem.

LA167 Evaluates Information-Oral
- The technician can evaluate the usefulness of oral information provided by customers or associates when analyzing a problem.

LA180 Evaluates Information-Written
- The technician evaluates the usefulness of available written information for clarity and adequacy when analyzing a problem.

| | | | | |
|---|---|---|---|---|
| LA215 | Identifies | Information-Written | Abbreviations/Acronyms | - The technician can identify and use written abbreviations and acronyms in diagnosis and problem solving. |
| LA231 | Identifies | Purpose/Strategy | Listening/Reading/Speaking/Writing | - The technician identifies both purpose and effective strategies for listening, reading, speaking, and writing when dealing with customers, associates, and supervisors. |
| LA236 | Infers/Predicts | Information-Oral | | - The technician makes inferences and recommends solutions to problems based on discussions with customers, associates and supervisors. |
| LA247 | Infers/Predicts | Information-Written | | - The technician makes inferences and predicts the solution to the problem from the information provided on the work order. |
| LA266 | Presents | Informal Speech | Information Requests | - The technician requests specific information relative to the symptoms of the problem from the customer, and possible solutions to the problem from associates and supervisors. |
| LA267 | Presents | Informal Speech | Information Supplying | - The technician supplies clarifying information to customers, associates, the parts supplier, and the supervisor. |
| LA271 | Uses | Dictionary | | -The technician refers to the dictionary to define terms or to check spelling. |
| LA278 | Uses | Text Resources | | - The technician uses text resources such as glossaries of terms, service manual indexes, database menus, and tables of contents to gather data for diagnosis and repair. |
| LA283 | Uses | Media Resources | Databases | - The technician uses computerized and other databases to obtain system information. |
| LA285 | Comprehends | Information-Written | Operator's Manual | - The technician can comprehend and apply information in the operator's manuals to operate and maintain automotive and autobody tools and equipment. |
| LA286 | Uses | Text Resources | Service (Shop) Manual | - The technician uses the service manual, in both database and hard copy formats, to identify the manufacturer's specifications for system operation, component specifications, and formulas for mixing various compounds. |

# RELATED ACADEMIC SKILLS CROSSWALK FOR THE MATH SKILLS EMBEDDED IN THE FIVE NATEF COLLISION REPAIR AND REFINISH TECHNICIAN SPECIALTY AREAS

| COLLISION REPAIR AND REFINISH TECHNICIAN COMPOSITE LIST<br>RAS CODE | DESCRIPTION | I. Structural Analysis and Damage Repair | II. Non-Structural Analysis and Damage Repair | III. Mechanical and Electrical Components | IV. Plastic Repair | V. Painting and Refinishing |
|---|---|---|---|---|---|---|
| MA001 | Calculates/Evaluates Algebraic Expressions | | | • | | |
| MA013 | Calculates/Evaluates Mean/Median/Mode | • | • | • | | |
| MA014 | Calculates/Evaluates Measurement Precision | • | | • | | |
| MA026 | Computes Addition Decimals | • | • | • | | • |
| MA028 | Computes Addition Mentally | • | • | • | • | • |
| MA034 | Computes Addition Whole Numbers | • | • | • | • | • |
| MA039 | Computes Division Decimals | • | • | • | • | • |
| MA047 | Computes Division Whole Numbers | • | • | • | • | • |
| MA065 | Computes Multiplication Decimals | • | • | • | • | • |
| MA067 | Computes Multiplication Mentally | • | • | • | • | • |
| MA073 | Computes Subtraction Whole Numbers | • | • | • | • | • |
| MA084 | Computes Subtraction Decimals | • | • | • | • | • |
| MA086 | Computes Subtraction Mentally | • | • | • | • | • |
| MA092 | Computes Subtraction Whole Numbers | • | • | • | • | • |
| MA126 | Converts Units English/Metric -- Feet/Meters, e.g. | • | • | • | • | • |
| MA128 | Distinguishes Angles/Circles/Arcs | • | | • | | |
| MA129 | Distinguishes Congruence/Similarity Geometric Figures | • | | • | | |
| MA131 | Distinguishes Equal/Not Equal | • | | • | | |
| MA132 | Distinguishes Estimate/Exact Value | • | | | | |
| MA140 | Estimates/Rounds Expected Outcomes Everyday Occurrences | • | • | • | | |
| MA146 | Estimates/Rounds Numbers Add/Subtract/Divide/Multiply | • | • | | | |
| MA153 | Formulates/Verifies Angles | • | • | • | • | • |
| MA161 | Identifies English Measures Length/Volume/Weight | • | • | • | • | • |
| MA168 | Identifies Lines Parallel/Perpendicular | • | • | • | | |
| MA170 | Identifies Lines Vertical/Horizontal | • | • | • | | |
| MA171 | Identifies Metric Measures Length/Volume/Weight | • | • | • | • | • |

## RELATED ACADEMIC SKILLS CROSSWALK FOR THE MATH SKILLS EMBEDDED IN THE FIVE NATEF COLLISION REPAIR AND REFINISH TECHNICIAN SPECIALTY AREAS

COLLISION REPAIR AND REFINISH TECHNICIAN COMPOSITE LIST

| RAS CODE | DESCRIPTION | I. Structural Analysis and Damage Repair | II. Non-Structural Analysis and Damage Repair | III. Mechanical and Electrical Components | IV. Plastic Repair | V. Painting and Refinishing |
|---|---|---|---|---|---|---|
| MA174 | Interprets Charts/Tables/Graphs | • | • | • | • | • |
| MA176 | Interprets Symbols <, >, =, e.g. | • | • | • | • | • |
| MA177 | Interprets System of Numbers Place Value | • | • | • | • | • |
| MA180 | Measures Direct Angles | • | • | • | | |
| MA181 | Measures Direct Distance | • | • | • | • | • |
| MA182 | Measures Direct Temperature | | | | • | • |
| MA183 | Measures Direct Time | | • | | • | • |
| MA184 | Measures Direct Volume | | | • | | |
| MA185 | Measures Direct Weight | | • | | | |
| MA186 | Measures Indirect | • | • | • | • | • |
| MA190 | Measures Metric Distance | • | • | • | • | • |
| MA191 | Measures Metric Temperature | | | | | • |
| MA192 | Measures Metric Volume | • | • | | • | • |
| MA193 | Measures Metric Weight | | | | | • |
| MA229 | Solves Problems Generates Conclusions Deductive Reasoning | | | • | | |
| MA239 | Understands Conditionals | • | | • | | |
| MA242 | Understands Definitions Standards | • | • | • | • | • |
| MA244 | Understands Geometric Figures Visual Perception | • | • | • | | |
| MA245 | Understands Line/Angle Relationships | • | • | • | • | |
| MA271 | Determines Proper Operation | • | • | • | • | • |
| MA273 | Computes Tolerances/Ranges Mentally | • | • | • | • | • |
| MA274 | Computes Proper Operations Mentally | • | • | • | • | • |
| MA275 | Identifies Temperatures Fahrenheit/Centigrade | | • | | • | • |

# Mathematics Related Academic Skills for the NATEF Collision Repair and Refinish Technician Task Lists

MA001 Calculates/Evaluates Algebraic Expressions

- The technician can use Ohm's Law to determine electrical circuit parameters that are out-of-tolerance.

MA013 Calculates/Evaluates Mean/Median/Mode

- The technician can calculate the average (mean) of several different measurements to determine any variance from the manufacturer's specifications.

MA014 Calculates/Evaluates Measurement Precision

- The technician uses a variety of techniques to determine if selected measurements are precise and in congruence with manufacturer's specifications.

MA026 Computes Addition Decimals

- The technician can add numbers that include decimals to determine conformance with the manufacturer's specifications.

MA028 Computes Addition Mentally

- The technician can mentally add two or more numbers to determine conformance with the manufacturer's specifications.

MA034 Computes Addition Whole Numbers

- The technician can add whole numbers to accurately determine measurement conformance with the manufacturer's specifications.

MA039 Computes Division Decimals

- The technician can divide decimals to determine measurement conformance with the manufacturer's specifications.

MA047 Computes Division Whole Numbers

- The technician can divide whole numbers to determine differences for comparison with the manufacturer's specifications.

MA065 Computes Multiplication Decimals

- The technician can multiply numbers that include decimals to determine conformance with the manufacturer's specifications.

MA067 Computes Multiplication Mentally

- The technician can mentally multiply numbers that include decimals to determine conformance with the manufacturer's specifications.

MA073 Computes Subtraction Whole Numbers

- The technician can subtract whole numbers to determine differences for comparison with the manufacturer's specifications.

MA084 Computes Subtraction Decimals

- The technician can subtract numbers that include decimals to determine conformance with the manufacturer's specifications.

MA086 Computes Subtraction Mentally

- The technician can mentally subtract numbers to arrive at a difference for comparison with the manufacturer's specifications.

MA092 Computes Subtraction Whole Numbers
- The technician can subtract whole numbers to determine differences for comparison with the manufacturer's specifications.

MA126 Converts Units English/Metric -- Feet/Meters, e.g.
- The technician can measure/test with tools designed for English or metric measurements and then convert the resulting measurement to the system used by the manufacturers for specifying the correct measurement or tolerance.

MA128 Distinguishes Angles/Circles/Arcs
- The technician must be highly skilled in determining if certain angles, circles, or arcs have the proper shape and relationship after an impact has distorted or misaligned them.

MA129 Distinguishes Congruence/Similarity Geometric Figures
- The technician can distinguish whether or not the angle between related parts (e.g. body or suspension components) is within the manufacturer's specifications.

MA131 Distinguishes Equal/Not Equal
- The technician can distinguish when a measurement or tolerance is not equal to the manufacturer's specification.

MA132 Distinguishes Estimate/Exact Value
- The technician can distinguish the need to use an exact value versus an estimated value, depending upon the structural damage and integrity of the system.

MA140 Estimates/Rounds Expected Outcomes Everyday Occurrences
- The technician estimates the anticipated performance outcome of a normally operating system as well as the expected outcome of everyday occurrences such as the result of a body parameter being out of conformance with the manufacturer's specifications.

MA146 Estimates/Rounds Numbers Add/Subtract/Divide/Multiply
- The technician can estimate the results of basic arithmetic operations, and can accurately round up or down depending on the appropriate rule for the situation.

MA153 Formulates/Verifies Angles
- The technician can visually formulate an angle (e.g. suspension system, chassis, or body component alignment) and verify its conformance to the manufacturer's specified angle as well as the angle of the spray pattern or spray equipment.

MA161 Identifies English Measures Length/Volume/Weight
- The technician can determine the degree of conformance to the manufacturer's specifications for length, volume and any other appropriate measurements in the English system.

MA168 Identifies Lines Parallel/Perpendicular
- The technician can use measurement devices to determine the parallelism or perpendicularity of chassis, suspension, and other vehicle dimension requiring geometric alignment principles.

MA170 Identifies Lines Vertical/Horizontal
- The technician must be very skilled in determining if the lines of an automobile are vertical or horizontal as specified in the original design specifications.

MA171 Identifies Metric Measures Length/Volume/Weight
- The technician can determine the degree of conformance to the manufacturer's specifications for length, volume and other appropriate measurements using the metric system.

MA174 Interprets Charts/Tables/Graphs
- The technician can interpret charts, tables, or graphs to determine the manufacturer's specifications for a given system.

MA176 Interprets Symbols <, >, =, e.g.
- The technician interprets symbols to determine compliance with the manufacturer's specifications.

MA177 Interprets System of Numbers Place Value
- The technician is able to interpret place value (tenths, hundredths, thousandths) when conducting precision measurements.

MA180 Measures Direct Angles
- The technician can use angle measurement equipment and techniques to determine any vehicle angle measurement variance from the manufacturer's specifications.

MA181 Measures Direct Distance
- The technician can measure distance using a variety of devices to determine conformance to the manufacturer's tolerances and specifications.

MA182 Measures Direct Temperature
- The technician can use appropriate temperature measurement tools to determine the existing temperature of ambient air and that of paints and inhibitors.

MA183 Measures Direct Time
- The technician needs to measure time since it is very critical to the proper mixing, application, and drying of certain finishes and substances.

MA184 Measures Direct Volume
- The technician can use various measurements to determine the volume of finishing and filler compounds to be applied or mixed.

MA185 Measures Direct Weight
- The technician uses scales to determine whether the weight of a given component is in conformance with the manufacturer's specified weight.

MA186 Measures Indirect
- The technician can use various forms of indirect measurement to determine if components are in conformance with manufacturer's specifications.

MA190 Measures Metric Distance
- The technician can use metric measurement instruments to determine correct sizes or distances in the metric system.

MA191 Measures Metric Temperature
- The technician can use metric temperature measurement instruments to determine ambient air temperature and that of paints and inhibitors.

MA192 Measures Metric Volume
- The technician can determine the volume of a vessel when the specifications are in liters.

MA193 Measures Metric Weight
- The technician can use metric weighing devices to determine the conformance of a weight to metric tolerances.

MA229 Solves Problems Generates Conclusions Deductive Reasoning
- The technician can identify the specific cause of the described problem by generating conclusions based on known symptoms related to the problem.

MA239 Understands Conditionals
- The technician understands that if the described problem has certain conditions (symptoms), then there are a limited number of probable solutions to the problem.

MA242 Understands Definitions Standards
- The technician can use and conform to standards defined by each manufacturer for the system being analyzed.

MA244 Understands Geometric Figures Visual Perception
- The technician can visually perceive the geometric relationships of systems and subsystems requiring alignment or verification.

MA245 Understands Line/Angle Relationships
- The technician understands the necessity of verifying that the relationship of parallel lines and angles concur with the manufacturer's specifications when diagnosing the alignment of a body component, chassis, or steering and suspension system.

MA271 Determines Proper Operation
- The technician can determine the proper sequence of arithmetic operations to arrive at a solution when comparing system measurements to the manufacturer's specifications.

MA273 Computes Tolerances/Ranges Mentally
- When comparing the observed measurement to the manufacturer's specifications, the technician can mentally compute whether the observed measurement is out-of-tolerance.

MA274 Computes Proper Operations Mentally
- The technician can determine the proper mathematical operation (addition, multiplication, subtraction or division) and mentally arrive at a solution.

MA275 Identifies Temperatures Fahrenheit/Centigrade
- The technician can identify whether a temperature measurement should be made using a Fahrenheit or Centigrade measuring device.

# RELATED ACADEMIC SKILLS CROSSWALK FOR THE SCIENCE SKILLS EMBEDDED IN THE FIVE NATEF COLLISION REPAIR AND REFINISH TECHNICIAN SPECIALTY AREAS

| COLLISION REPAIR AND REFINISH TECHNICIAN COMPOSITE LIST RAS CODE | DESCRIPTION | I. Structural Analysis and Damage Repair | II. Non-Structural Analysis and Damage Repair | III. Mechanical and Electrical Components | IV. Plastic Repair | V. Painting and Refinishing |
|---|---|---|---|---|---|---|
| SC007 | Analyzes/Evaluates Environmental Issues | • | • | • | • | • |
| SC012 | Analyzes/Evaluates Environmental Issues Waste Management | • | • | • | • | • |
| SC041 | Applies/Uses Laboratory Techniques Safety | • | • | • | • | • |
| SC042 | Applies/Uses Maps/Charts/Tables/Graphs | • | • | • | • | • |
| SC044 | Applies/Uses Scientific Methods | • | • | • | • | • |
| SC052 | Converts Measurement Units English/Metric | • | • | • | • | • |
| SC114 | Describes/Explains Chemical Reactions | • | • | | • | • |
| SC116 | Describes/Explains Chemical Reactions Catalysts | • | • | | • | • |
| SC121 | Describes/Explains Chemical Reactions Inhibitors | • | • | | • | • |
| SC127 | Describes/Explains Pigmentation/Color | | | | | • |
| SC130 | Describes/Explains Color Spectrum | | | | | • |
| SC177 | Describes/Explains Electricity | | • | • | | |
| SC178 | Describes/Explains Batteries | | • | • | | |
| SC180 | Describes/Explains Conductors | | • | • | | |
| SC182 | Describes/Explains Current AC-DC | | | • | | |
| SC184 | Describes/Explains Electricity Ground | • | • | • | | |
| SC186 | Describes/Explains Electricity Parallel/Series Circuits | • | | • | | |
| SC187 | Describes/Explains Electricity Short Circuit | • | • | • | | |
| SC194 | Describes/Explains Electricity - Generating Motors | | | • | | |
| SC197 | Describes/Explains Electricity - Generating Transformers | | | • | | |
| SC198 | Describes/Explains Electricity - Measurement | | | • | | |
| SC199 | Describes/Explains Electricity - Measurement Ammeter/Voltmeter | | • | • | | |
| SC201 | Describes/Explains Electricity - Measurement Fuse | | • | • | | |
| SC204 | Describes/Explains Electricity - Measurement Resistance | | • | • | | |
| SC205 | Describes/Explains Electricity - Measurement Voltage | | • | • | | |
| SC212 | Describes/Explains Electrochemical Reactions Activity of Metals | • | • | • | | • |

# RELATED ACADEMIC SKILLS CROSSWALK FOR THE SCIENCE SKILLS EMBEDDED IN THE FIVE NATEF COLLISION REPAIR AND REFINISH TECHNICIAN SPECIALTY AREAS

COLLISION REPAIR AND REFINISH TECHNICIAN COMPOSITE LIST

| RAS CODE | DESCRIPTION | I. Structural Analysis and Damage Repair | II. Non-Structural Analysis and Damage Repair | III. Mechanical and Electrical Components | IV. Plastic Repair | V. Painting and Refinishing |
|---|---|---|---|---|---|---|
| SC213 | Describes/Explains Electrochemical Reactions Oxidation/Reduction | • | • | • | | • |
| SC217 | Describes/Explains Electromagnetism Magnetic Fields/Force | • | • | • | | |
| SC219 | Describes/Explains Electromagnetism Magnets | | | | | • |
| SC236 | Describes/Explains Energy Momentum | • | • | • | | |
| SC248 | Describes/Explains Force | • | | | | |
| SC249 | Describes/Explains Energy Force, Balanced/Unbalanced | | • | • | | |
| SC253 | Describes/Explains Force Inertia | • | • | | | |
| SC255 | Describes/Explains Force Pressure | • | • | • | | • |
| SC274 | Describes/Explains Heat Conduction/Convection | • | • | • | • | • |
| SC277 | Describes/Explains Heat Expansion/Contraction | • | • | | • | • |
| SC278 | Describes/Explains Heat Fusion/Vaporization | • | • | | • | • |
| SC280 | Describes/Explains Heat Insulation | • | • | | • | |
| SC282 | Describes/Explains Heat Temperature | • | • | | • | • |
| SC321 | Describes/Explains Light Angle of Incidence/Reflection | | | | | • |
| SC329 | Describes/Explains Light Opaque | | | | | • |
| SC335 | Describes/Explains Light Translucent/Transparent | | | | | • |
| SC336 | Describes/Explains Light Ultraviolet | | | | | • |
| SC338 | Describes/Explains Matter Density/Specific Gravity | | • | • | | |
| SC341 | Describes/Explains Matter Phases/States | • | • | | • | • |
| SC355 | Describes/Explains Motion Velocity | | | | | • |
| SC395 | Describes/Explains Solutions Solvent | • | • | | • | • |
| SC399 | Describes/Explains Sound Carriers/Insulators | • | • | • | | |
| SC404 | Describes/Explains Sound Frequency-Hertz | • | • | • | | |
| SC406 | Describes/Explains Sound Noise/Acoustics | • | • | • | | |
| SC411 | Describes/Explains Sound Resonance | • | • | • | | |
| SC443 | Describes/Explains Weather/Climate Relative Humidity | • | • | | • | • |

## RELATED ACADEMIC SKILLS CROSSWALK FOR THE SCIENCE SKILLS EMBEDDED IN THE FIVE NATEF COLLISION REPAIR AND REFINISH TECHNICIAN SPECIALTY AREAS

| COLLISION REPAIR AND REFINISH TECHNICIAN COMPOSITE LIST RAS CODE | DESCRIPTION | I. Structural Analysis and Damage Repair | II. Non-Structural Analysis and Damage Repair | III. Mechanical and Electrical Components | IV. Plastic Repair | V. Painting and Refinishing |
|---|---|---|---|---|---|---|
| SC447 | Describes/Explains Work Levers | • | | | | |
| SC448 | Describes/Explains Work Pulleys | • | | | | |
| SC467 | Identifies Definitions Operational | • | • | • | • | • |
| SC489 | Measures Distance/Length | • | • | • | • | • |
| SC492 | Measures Force | • | • | • | • | |
| SC493 | Measures Mass/Weight | • | • | | | • |
| SC494 | Measures Pressure | | | • | | • |
| SC495 | Measures Temperature Fahrenheit/Centigrade | • | • | • | • | • |
| SC496 | Measures Time | • | • | • | • | • |
| SC497 | Measures Volume Liquids/Solids | • | • | • | • | • |
| SC499 | Uses Computers Information Processing/Estimating | • | • | • | • | • |
| SC502 | Measures Parameters Electrical | • | • | • | | |
| SC503 | Describes/Explains Fluid System Hydraulics | • | • | • | | |
| SC504 | Describes/Explains Fluid System Pneumatics | • | • | • | • | • |
| SC507 | Describes/Explains Motion Lubrication | | | • | | |
| SC508 | Describes/Explains Matter Metallurgy | • | • | | | • |
| SC509 | Describes/Explains Electricity Capacitance | | | • | | |
| SC510 | Describes/Explains Fluid System Dynamics | | | | | • |
| SC511 | Describes/Explains Matter Surface Process (Absorption/Adsorption) | • | • | | • | • |
| SC512 | Describes/Explains Chemical Reactions Contamination | | | • | | • |
| SC513 | Describes/Explains Force Torque | • | • | • | • | |
| SC514 | Describes/Explains Electricity Semiconductor Devices | • | • | • | | |
| SC515 | Describes/Explains Work Simple Machines | • | • | • | | |
| SC516 | Describes/Explains Motion Rotational | | | • | | |
| SC517 | Describes/Explains Electricity-Generating Generators | | | • | | |
| SC518 | Describes/Explains Electricity Mechanical Transducers | • | • | • | | |

## RELATED ACADEMIC SKILLS CROSSWALK FOR THE SCIENCE SKILLS EMBEDDED IN THE FIVE NATEF COLLISION REPAIR AND REFINISH TECHNICIAN SPECIALTY AREAS

| COLLISION REPAIR AND REFINISH TECHNICIAN COMPOSITE LIST RAS CODE | DESCRIPTION | I. Structural Analysis and Damage Repair | II. Non-Structural Analysis and Damage Repair | III. Mechanical and Electrical Components | IV. Plastic Repair | V Painting and Refinishing |
|---|---|---|---|---|---|---|
| SC520 | Measures Flow Rate | | | | | • |
| SC521 | Describes/Explains Flow Rate | | | | | • |
| SC522 | Applies/Uses Ratio Proportion Mixtures | • | • | | • | • |
| SC527 | Describes/Explains Acids/Bases/pH | | | | | • |
| SC528 | Describes/Explains Adhesives/Sealants | • | • | | • | • |
| SC529 | Identifies Physical Properties Glass/Polymers | • | • | • | • | • |
| SC530 | Describes/Explains Chemical Reactions Activators | | • | | • | • |
| SC531 | Describes/Explains Viscosity | • | • | • | • | • |
| SC532 | Describes/Explains Light Source | | | | | • |

## Science Related Academic Skills
## for the
## NATEF Collision Repair and Refinish Technician Task Lists

SC007 Analyzes/Evaluates Environmental Issues
- The technician develops and maintains an understanding of all federal, state, and local rules and regulations regarding environmental issues related to the work of the autobody technician. The technician uses such things as government impact statements, media information, and general knowledge of pollution and waste management to correctly use and dispose of products that result from the performance of a repair task.

SC012 Analyzes/Evaluates Environmental Issues Waste Management
- The technician evaluates the waste products resulting from an automobile body repair task and handles the disposal of materials in accordance with applicable federal, state, and local rules and regulations.

SC041 Applies/Uses Laboratory Techniques Safety
- The technician follows all safety regulations and applicable procedures while performing the task.

SC042 Applies/Uses Maps/Charts/Tables/Graphs
- The technician uses the information in service manual charts, tables, or graphs to determine the manufacturer's specifications for components and the appropriate repair/replacement procedure and/or part.

SC044 Applies/Uses Scientific Methods
- The technician develops a theory relative to the cause of the problem based on the information provided, then tests the hypothesis to determine the solution. Major steps include: ① identify the problem; ② gather information; ③ develop hypothesis; ④ take action; ⑤ check results.

SC052 Converts Measurement Units English/Metric
- The technician can convert measurements taken in the English or metric system to specifications stated in terms of either system.

SC114 Describes/Explains Chemical Reactions
- The technician can demonstrate an understanding of the chemical reaction that occurs in various substances used in the automobile.

SC116 Describes/Explains Chemical Reactions Catalysts
- The technician can explain the role a catalyst plays in the mixing of fillers or finishes for use on the automobile body.

SC121 Describes/Explains Chemical Reactions Inhibitors
- The technician can explain the purpose of adding additives to an autobody repair compound.

SC127 Describes/Explains Pigmentation/Color
- The technician can describe and explain the role that pigmentation plays in determining the specific shade of an automobile body or interior color.

SC130 Describes/Explains Color Spectrum
- The technician demonstrates an understanding of the total spectrum of color by explaining the roles different colors play in a mixture.

SC177 Describes/Explains Electricity
- The technician can demonstrate an understanding of and explain the properties of electricity that impact the lighting, engine management, and other electrical systems of a vehicle.

SC178 Describes/Explains Batteries
- The technician can demonstrate an understanding of the electrochemical reactions that occur in wet and dry cell batteries.

SC180 Describes/Explains Conductors
- The technician can explain the difference between electrical conductors and insulators.

SC182 Describes/Explains Current AC-DC
- The technician can explain the difference between direct and alternating current.

SC184 Describes/Explains Electricity Ground
- The technician can demonstrate an understanding of the characteristics of a quality electrical ground and the problems associated with having an electrical circuit that is inadequately grounded.

SC186 Describes/Explains Electricity Parallel/Series Circuits
- The technician can explain current flow and voltage in both parallel and series circuits.

SC187 Describes/Explains Electricity Short Circuit
- The technician can demonstrate an understanding of the processes used to locate a short circuit in the electrical/electronic system.

SC194 Describes/Explains Electricity - Generating Motors
- The technician can demonstrate an understanding of the role of the generator in maintaining battery and system voltage.

SC197 Describes/Explains Electricity - Generating Transformers
- The technician can explain the ignition coil transformer's role in generating the high voltage required operate a component.

SC198 Describes/Explains Electricity - Measurement
- The technician can demonstrate an understanding of the correct procedure to measure the electrical parameters of voltage, current, resistance, or power.

SC199 Describes/Explains Electricity - Measurement Ammeter/Voltmeter
- The technician can demonstrate an understanding of how to correctly measure electrical current and voltage in a circuit.

SC201 Describes/Explains Electricity - Measurement Fuse
- The technician can demonstrate an understanding of and explain the role of a fuse or fusible link when used as a protective device in an electrical or electronic circuit.

SC204 Describes/Explains Electricity - Measurement Resistance
- The technician can demonstrate an understanding of the relationship of resistance to heat, voltage drop, and circuit parameters.

SC205 Describes/Explains Electricity - Measurement Voltage
- The technician can demonstrate an understanding of and explain system voltage generation, uses, and characteristics.

SC212 Describes/Explains Electrochemical Reactions Activity of Metals
- The technician can explain the conductivity problems in a circuit when connectors corrode due to electrochemical reactions.

SC213 Describes/Explains Electrochemical Reactions Oxidation/Reduction
- The technician can explain the effect of oxidation on electrical connections as well as on an automotive finish.

SC217 Describes/Explains Electromagnetism Magnetic Fields/Force
- The technician can explain the effect of magnetic fields on unshielded circuits and voltages induced in other circuits by the magnetic fields.

SC219 Describes/Explains Electromagnetism Magnets
- The technician can explain how attaching magnets to an automobile body can cause paint to be evenly distributed through the principles of magnetism.

SC236 Describes/Explains Energy Momentum
- The technician can explain how energy is dissipated through the body based on the momentum of the vehicle at the time of the impact.

SC248 Describes/Explains Force
- The technician can explain the principles of force as it applies to the realignment of a component.

SC249 Describes/Explains Energy Force, Balanced/Unbalanced
- The technician can demonstrate an understanding of the role of balanced and unbalanced forces on linear or rotating vehicle assemblies.

SC253 Describes/Explains Force Inertia
- The technician can explain how the rate of a force in motion can impact on an automobile body in a variety of ways.

SC255 Describes/Explains Force Pressure
- The technician can demonstrate an understanding of the concept of pressure in relation to the concept of force.

SC274 Describes/Explains Heat Conduction/Convection
- The technician is able to explain the concept of heat transfer in terms of conduction, radiation, and convection in various automotive systems.

SC277 Describes/Explains Heat Expansion/Contraction
- The technician is able to demonstrate an understanding of the expansion and contraction of various system parts as a result of heat generated during the use and cooling of the system when not in operation.

SC278 Describes/Explains Heat Fusion/Vaporization
- The technician can demonstrate an understanding of the effect of how adding heat causes a change in state of matter, such as from a solid to a liquid to a gas.

SC280 Describes/Explains Heat Insulation

- The technician can explain the role of insulation in maintaining stable temperatures or in preventing the transfer of heat to an unwanted area.

SC282 Describes/Explains Heat Temperature

- The technician can explain the differences between heat and temperature and demonstrate an understanding of how to measure each.

SC321 Describes/Explains Light Angle of Incidence/Reflection

- The technician can explain how the angle or amount of light can impact on the appearance of a given finish in terms of texture and quality of finish.

SC329 Describes/Explains Light Opaque

-The technician can explain color and shades of color based on how light hits it.

SC335 Describes/Explains Light Translucent/Transparent

- The technician can explain the difference between the principles of translucent light (diffuses) as contrasted to transparent light (passes through).

SC336 Describes/Explains Light Ultraviolet

- The technician can explain how ultraviolet rays can cause a finish or substance to deteriorate.

SC338 Describes/Explains Matter Density/Specific Gravity

- The technician can explain the need for a specific gravity test of battery electrolyte to determine charge.

SC341 Describes/Explains Matter Phases/States

- The technician can explain in detail the three states of matter.

SC355 Describes/Explains Motion Velocity

- The technician can explain how the velocity of an object in motion impacts on another object.

SC395 Describes/Explains Solutions Solvent

- The technician understands the use and safety requirements of all solvents used in an autobody environment.

SC399 Describes/Explains Sound Carriers/Insulators

- The technician can demonstrate an understanding of how sound generated in one place in the body and engine can be carried to other parts of the body or engine through metal and other materials.

SC404 Describes/Explains Sound Frequency-Hertz

- The technician is able to explain the relationship of the frequency of the sound to a normal or abnormally operating system.

SC406 Describes/Explains Sound Noise/Acoustics

- The technician is able to demonstrate an understanding of why a specific noise sounds different depending on the acoustics of the vehicle.

SC411 Describes/Explains Sound Resonance

- The technician can demonstrate an understanding of what happens when an object resonates.

SC443 Describes/Explains Weather/Climate Relative Humidity
- The technician can demonstrate an understanding of and discuss relative humidity in terms of effect on paint and substance applications.

SC447 Describes/Explains Work Levers
- The technician can explain how levers can be used to increase an applied force over distance.

SC448 Describes/Explains Work Pulleys
- The technician can explain how pulleys can be used to increase an applied force over distance.

SC467 Identifies Definitions Operational
- The technician is able to identify and define terms that specifically relate to systems, diagnosis, service, and repair.

SC489 Measures Distance/Length
- The technician uses precision measuring devices to determine if wear and adjustments are within the manufacturer's specifications, and to assure that replacement parts meet the manufacturer's specifications.

SC492 Measures Force
- The technician uses tension gauges such as a torque wrench to measure the force or tension required to tighten connections according to the manufacturer's specifications.

SC493 Measures Mass/Weight
- The technician uses a scale to measure component weight in order to mix an adhesive or to determine the strength and integrity of a component or part.

SC494 Measures Pressure
- The technician uses pressure measuring tools to determine pressures in hydraulic or pneumatic paint systems and compares them to the manufacturer's specifications.

SC495 Measures Temperature Fahrenheit/Centigrade
- The technician uses direct and indirect methods to measure system temperatures and then converts them to Fahrenheit or Centigrade as required by the manufacturer for proper cure and application times.

SC496 Measures Time
- The technician uses direct and indirect methods to measure application times, mixing guidelines for certain products, and labor time guides for selected tasks.

SC497 Measures Volume Liquids/Solids
- The technician uses direct and indirect methods to measure the volume of liquids in a mixture for adhesion purposes.

SC499 Uses Computers Information Processing
- The technician uses computer databases for information retrieval and for input devices to process information for customers, billing purposes, warranty work, and other record-keeping purposes.

SC502 Measures Parameters Electrical
- The technician uses precision electrical test equipment to measure current, voltage, resistance, continuity, and/or power.

SC503 Describes/Explains Fluid System Hydraulics
- The technician can explain how an applied force at one location can be transmitted via fluid pressure to provide a force at a remote location such as in the brake system or with selected tools and equipment used to realign the automobile body and structure.

SC504 Describes/Explains Fluid System Pneumatics
- The technician can demonstrate an understanding of the physical properties in pneumatic systems, tools and equipment.

SC507 Describes/Explains Motion Lubrication
- The technician can discuss the role of lubrication in relation to the concept of friction.

SC508 Describes/Explains Matter Metallurgy
- The technician can explain the criticality of metals with different hardness, depending on the function and location of the metal as well as how fillers and finishes adhere to metal.

SC509 Describes/Explains Electricity Capacitance
- The technician can demonstrate an understanding of the role of capacitance in timer circuits, such as RC timers or a MAP sensor wherein the changing manifold pressure causes two metal discs to act like a capacitor, sending a varying voltage to the electronic component control system.

SC510 Describes/Explains Fluid System Dynamics
- The technician can explain the dynamic control properties of a hydraulic system in terms of its impact on spray patterns, volume, etc.

SC511 Describes/Explains Matter Surface Process (Absorption/Adsorption)
- The technician can explain the surface process that occurs on system seals due to absorption of the contained materials.

SC512 Describes/Explains Chemical Reactions Contamination
- The technician can demonstrate an understanding of how a contaminated liquid can cause a chemical reaction which can result in the deterioration of the finish or a plastic component.

SC513 Describes/Explains Force Torque
- The technician can demonstrate an understanding of how torque relates to force and angular acceleration.

SC514 Describes/Explains Electricity Semiconductor Devices
- The technician can demonstrate an understanding of the ability of semiconductor devices to rapidly modify component operational parameters depending on inputs from sensors such as for the air bag or AC system.

SC515 Describes/Explains Work Simple Machines
- The technician can demonstrate an understanding of how cams, pulleys, and levers are used to multiply force or transfer directions of force in a mechanical system.

SC516 Describes/Explains Motion Rotational
- The technician can explain how rotational motion can be changed to linear motion and why balance is important in these rotating systems.

SC517 Describes/Explains Electricity-Generating Generators
- The technician can explain how a generator operates as well as its ability to provide a continuous flow of electricity to a system.

SC518 Describes/Explains Electricity Mechanical Transducers
- The technician can demonstrate an understanding of the role mechanical transducers play in sending an electrical control signal to modify the system's operating characteristics.

SC520 Measures Flow Rate
- The technician can use precision gauges or instruments to measure the flow rate of air in a painting application.

SC521 Describes/Explains Flow Rate
- The technician can demonstrate an understanding of how variances in flow rate can effect the spray patters, thickness of coat, etc., in the finishing process.

SC522 Applies/Uses Ratio Proportion Mixtures
- The technician can correctly use proportions and ratios in mixing fillers, finishes, and other substances.

SC527 Describes/Explains Acids/Bases/pH
- The technician can explain the role that acids and bases have in altering compounds used on or in the automobile.

SC528 Describes/Explains Adhesives/Sealants
- The technician can demonstrate an understanding of how surface processes and cohesive/adhesive forces aid in glues, tapes, and sealants.

SC529 Identifies Physical Properties Glass/Polymers
- The technician can identify and use proper service procedures based on the physical properties of an automobile component or system that are made of glass or plastic.

SC530 Describes/Explains Chemical Reactions Activators
- The technician can describe or explain the role that activators have in causing a change in the chemical state of a compound or filler.

SC531 Describes/Explains Viscosity
- The technician can explain fluid viscosity as a measurement and why it is important to the application of fillers, plastics, and finishes.

SC532 Describes/Explains Light Source
- The technician can accurately locate and explain the properties of a given source of light.

# I. STRUCTURAL ANALYSIS AND DAMAGE REPAIR

## UNDUPLICATED LIST

### *LANGUAGE ARTS/COMMUNICATIONS SKILLS*

LA001 Adapts Diction/Structure
- The technician adapts diction and structure to the context of all verbal and written communication based on the audience, purpose, and specific situation.

LA005 Adapts Strategy Listening
- The technician adapts a listening strategy that will provide the information required for solving the problem.

LA006 Adapts Strategy Reading
- The technician adapts a reading strategy for all written materials, e.g. customer's notes, service manuals, shop manuals, technical bulletins, and computer/data feed readouts, etc., that will help identify the solution to the problem.

LA007 Adapts Strategy Speaking
- The technician adapts a communication strategy for the customer, supervisor, and fellow employees that will yield the highest quality usable information for problem solving.

LA008 Adapts Strategy Writing
- The technician adapts a writing strategy that is most appropriate for the intended audience (e.g. customers, supervisor, and fellow employees) when documenting repair information.

LA009 Adapts Style Purpose
- The technician adapts a style for speaking and writing that is consistent with the purpose of the communication format.

LA013 Applies/Uses Definitions
- The technician can apply industry definitions to solve problems in various components and systems of the automobile.

LA020 Applies/Uses Study Habits/Methods
- The technician uses study habits and methods when consulting the manufacturer's publications, e.g. shop manuals, references, and computer databases.

LA022 Applies/Uses Study Habits/Methods Prior Knowledge
- The technician uses prior knowledge of similar situations to determine the specific cause(s) of the problem.

LA023 Applies/Uses Study Habits/Methods Skimming/Scanning
- The technician will visually skim or scan the manufacturer's service manuals or databases to identify information that is related to any unfamiliar system under review, then study the applicable information with the intensity necessary for the situation.

LA035 Attends Directions/Task
- The technician attends to all written and oral directions that relate to the task or system under study.

LA036 Attends Nonverbal Cues
- The technician attends to nonverbal cues in discussions with customers and associates to verify, identify, and solve problems.

LA037 Attends Verbal Cues
- The technician attends to verbal cues in discussions with customers and associates to verify, identify, and solve problems.

LA038 Collects/Organizes Information-Oral/Written
- The technician collects and organizes oral and written information based on discussions, notes, observations, personal experiences, and data collection that will assist in the problem analysis and solution process.

LA069 Composes/Edits Notes
- The technician makes notes regarding symptoms, possible causes of problems, and other data that will aid in the diagnosis and problem solving process.

LA074 Composes/Edits Paragraphs
- The technician composes complete and accurate paragraphs that include information regarding symptoms, diagnosis results, and appropriate details when preparing warranty claims and information for inclusion on work orders.

LA098 Composes/Edits Reports Summaries
- The technician uses appropriate grammar and sentence structure when summarizing problems and actions taken in reports.

LA099 Composes/Edits Sentences
- The technician uses conventional sentence structure, spelling, capitalization, and punctuation when composing sentences for warranty reports.

LA121 Comprehends Information-Oral
- The technician can comprehend information gathered during discussions with customers, supervisors, and associates regarding problem symptoms and potential solutions.

LA132 Comprehends Information-Written
- The technician can comprehend and apply available written information needed to diagnose, analyze, and solve problems.

LA134 Comprehends Information-Written Cause/Effect Relationships
- The technician comprehends and uses cause and effect relationships presented in service manual problem solving trees to diagnose faults in a component or system.

LA136 Comprehends Information-Written Charts/Tables/Graphs
- The technician consults charts, tables, or graphs to determine the manufacturer's specifications for component or system alignment.

LA147 Comprehends Information-Written Sequence
- The technician consults written information to determine the applicable technical sequence required for solving a specific problem.

LA167 Evaluates Information-Oral
- The technician can evaluate the usefulness of oral information provided by customers or associates when analyzing a problem.

LA180 Evaluates Information-Written
- The technician evaluates the usefulness of available written information for clarity and adequacy when analyzing a problem.

LA215 Identifies Information-Written Abbreviations/Acronyms
- The technician can identify and use written abbreviations and acronyms in diagnosis and problem solving.

LA231 Identifies Purpose/Strategy Listening/Reading/Speaking/Writing
- The technician identifies both purpose and effective strategies for listening, reading, speaking, and writing when dealing with customers, associates, and supervisors.

LA236 Infers/Predicts Information-Oral
- The technician makes inferences and recommends solutions to problems based on discussions with customers, associates and supervisors.

LA247 Infers/Predicts Information-Written
- The technician makes inferences and predicts the solution to the problem from the information provided on the work order.

LA266 Presents Informal Speech Information Requests
- The technician requests specific information relative to the symptoms of the problem from the customer, and possible solutions to the problem from associates and supervisors.

LA267 Presents Informal Speech Information Supplying
- The technician supplies clarifying information to customers, associates, the parts supplier, and the supervisor.

LA271 Uses Dictionary
-The technician refers to the dictionary to define terms or to check spelling.

LA278 Uses Text Resources
- The technician uses text resources such as glossaries of terms, service manual indexes, database menus, and tables of contents to gather data for diagnosis and repair.

LA283 Uses Media Resources Databases
- The technician uses computerized and other databases to obtain system information.

LA285 Comprehends Information-Written Operator's Manual
- The technician can comprehend and apply information in the operator's manuals to operate and maintain automotive and autobody tools and equipment.

LA286 Uses Text Resources Service (Shop) Manual
- The technician uses the service manual, in both database and hard copy formats, to identify the manufacturer's specifications for system operation, component specifications, and formulas for mixing various compounds.

## *MATH SKILLS*

MA013 Calculates/Evaluates Mean/Median/Mode
- The technician can calculate the average (mean) of several different measurements to determine any variance from the manufacturer's specifications.

MA014 Calculates/Evaluates Measurement Precision
- The technician uses a variety of techniques to determine if selected measurements are precise and in congruence with manufacturer's specifications.

MA026 Computes Addition Decimals
- The technician can add numbers that include decimals to determine conformance with the manufacturer's specifications.

MA028 Computes Addition Mentally
- The technician can mentally add two or more numbers to determine conformance with the manufacturer's specifications.

MA034 Computes Addition Whole Numbers
- The technician can add whole numbers to accurately determine measurement conformance with the manufacturer's specifications.

MA039 Computes Division Decimals
- The technician can divide decimals to determine measurement conformance with the manufacturer's specifications.

MA047 Computes Division Whole Numbers
- The technician can divide whole numbers to determine differences for comparison with the manufacturer's specifications.

MA065 Computes Multiplication Decimals
- The technician can multiply numbers that include decimals to determine conformance with the manufacturer's specifications.

MA067 Computes Multiplication Mentally
- The technician can mentally multiply numbers that include decimals to determine conformance with the manufacturer's specifications.

MA073 Computes Subtraction Whole Numbers
- The technician can subtract whole numbers to determine differences for comparison with the manufacturer's specifications.

MA084 Computes Subtraction Decimals
- The technician can subtract numbers that include decimals to determine conformance with the manufacturer's specifications.

MA086 Computes Subtraction Mentally
- The technician can mentally subtract numbers to arrive at a difference for comparison with the manufacturer's specifications.

MA092 Computes Subtraction Whole Numbers
- The technician can subtract whole numbers to determine differences for comparison with the manufacturer's specifications.

MA126 Converts Units English/Metric -- Feet/Meters, e.g.
- The technician can measure/test with tools designed for English or metric measurements and then convert the resulting measurement to the system used by the manufacturers for specifying the correct measurement or tolerance.

MA128 Distinguishes Angles/Circles/Arcs
- The technician must be highly skilled in determining if certain angles, circles, or arcs have the proper shape and relationship after an impact has distorted or misaligned them.

MA129 Distinguishes Congruence/Similarity Geometric Figures
- The technician can distinguish whether or not the angle between related parts (e.g. body or suspension components) is within the manufacturer's specifications.

MA131 Distinguishes Equal/Not Equal
- The technician can distinguish when a measurement or tolerance is not equal to the manufacturer's specification.

MA132 Distinguishes Estimate/Exact Value
- The technician can distinguish the need to use an exact value versus an estimated value, depending upon the structural damage and integrity of the system.

MA140 Estimates/Rounds Expected Outcomes Everyday Occurrences
- The technician estimates the anticipated performance outcome of a normally operating system as well as the expected outcome of everyday occurrences such as the result of a body parameter being out of conformance with the manufacturer's specifications.

MA146 Estimates/Rounds Numbers Add/Subtract/Divide/Multiply
- The technician can estimate the results of basic arithmetic operations, and can accurately round up or down depending on the appropriate rule for the situation.

MA153 Formulates/Verifies Angles
- The technician can visually formulate an angle (e.g. chassis or body component alignment) and verify its conformance to the manufacturer's specified angle.

MA161 Identifies English Measures Length/Volume/Weight
- The technician can determine the degree of conformance to the manufacturer's specifications for length, volume and any other appropriate measurements in the English system.

MA168 Identifies Lines Parallel/Perpendicular
- The technician can use measurement devices to determine the parallelism or perpendicularity of chassis, suspension, and other vehicle dimension requiring geometric alignment principles.

MA170 Identifies Lines Vertical/Horizontal
- The technician must be very skilled in determining if the lines of an automobile are vertical or horizontal as specified in the original design specifications.

MA171 Identifies Metric Measures Length/Volume/Weight
- The technician can determine the degree of conformance to the manufacturer's specifications for length, volume and other appropriate measurements using the metric system.

MA174 Interprets Charts/Tables/Graphs
- The technician can interpret charts, tables, or graphs to determine the manufacturer's specifications for a given system.

MA176 Interprets Symbols <, >, =, e.g.
- The technician interprets symbols to determine compliance with the manufacturer's specifications.

MA177 Interprets System of Numbers Place Value
- The technician is able to interpret place value (tenths, hundredths, thousandths) when conducting precision measurements.

MA180 Measures Direct Angles
- The technician can use angle measurement equipment and techniques to determine any vehicle angle measurement variance from the manufacturer's specifications.

MA181 Measures Direct Distance
- The technician can measure distance using a variety of devices to determine conformance to the manufacturer's tolerances and specifications.

MA186 Measures Indirect
- The technician can use various forms of indirect measurement to determine if components are in conformance with manufacturer's specifications.

MA190 Measures Metric Distance
- The technician can use metric measurement instruments to determine correct sizes or distances in the metric system.

MA192 Measures Metric Volume
- The technician can determine the volume of a vessel when the specifications are in liters.

MA239 Understands Conditionals
- The technician understands that if the described problem has certain conditions (symptoms), then there are a limited number of probable solutions to the problem.

MA242 Understands Definitions Standards
- The technician can use and conform to standards defined by each manufacturer for the system being analyzed.

MA244 Understands Geometric Figures Visual Perception
- The technician can visually perceive the geometric relationships of systems and sub-systems requiring alignment or verification.

MA245 Understands Line/Angle Relationships
- The technician understands the necessity of verifying that the relationship of parallel lines and angles concur with the manufacturer's specifications when diagnosing the alignment of a body component or chassis.

MA271 Determines Proper Operation
- The technician can determine the proper sequence of arithmetic operations to arrive at a solution when comparing system measurements to the manufacturer's specifications.

MA273 Computes Tolerances/Ranges Mentally
- When comparing the observed measurement to the manufacturer's specifications, the technician can mentally compute whether the observed measurement is out-of-tolerance.

MA274 Computes Proper Operations Mentally
- The technician can determine the proper mathematical operation (addition, multiplication, subtraction or division) and mentally arrive at a solution.

## *SCIENCE SKILLS*

SC007 Analyzes/Evaluates Environmental Issues
- The technician develops and maintains an understanding of all federal, state, and local rules and regulations regarding environmental issues related to the work of the autobody technician. The technician uses such things as government impact statements, media information, and general knowledge of pollution and waste management to correctly use and dispose of products that result from the performance of a repair task.

SC012 Analyzes/Evaluates Environmental Issues Waste Management
- The technician evaluates the waste products resulting from an automobile body repair task and handles the disposal of materials in accordance with applicable federal, state, and local rules and regulations.

SC041 Applies/Uses Laboratory Techniques Safety
- The technician follows all safety regulations and applicable procedures while performing the task.

SC042 Applies/Uses Maps/Charts/Tables/Graphs
- The technician uses the information in service manual charts, tables, or graphs to determine the manufacturer's specifications for components and the appropriate repair/replacement procedure and/or part.

SC044 Applies/Uses Scientific Methods
- The technician develops a theory relative to the cause of the problem based on the information provided, then tests the hypothesis to determine the solution. Major steps include: ① identify the problem; ② gather information; ③ develop hypothesis; ④ take action; ⑤ check results.

SC052 Converts Measurement Units English/Metric
- The technician can convert measurements taken in the English or metric system to specifications stated in terms of either system.

SC114 Describes/Explains Chemical Reactions
- The technician can demonstrate an understanding of the chemical reaction that occurs in various substances used in the automobile.

SC116 Describes/Explains Chemical Reactions Catalysts
- The technician can explain the role a catalyst plays in the mixing of fillers or finishes for use on the automobile body.

SC121 Describes/Explains Chemical Reactions Inhibitors
- The technician can explain the purpose of adding additives to an autobody repair compound.

SC184 Describes/Explains Electricity Ground
- The technician can demonstrate an understanding of the characteristics of a quality electrical ground and the problems associated with having an electrical circuit that is inadequately grounded.

SC186 Describes/Explains Electricity Parallel/Series Circuits
- The technician can explain current flow and voltage in both parallel and series circuits.

SC187 Describes/Explains Electricity Short Circuit
- The technician can demonstrate an understanding of the processes used to locate a short circuit in the electrical/electronic system.

SC212 Describes/Explains Electrochemical Reactions Activity of Metals
- The technician can explain the conductivity problems in a circuit when connectors corrode due to electrochemical reactions.

SC213 Describes/Explains Electrochemical Reactions Oxidation/Reduction
- The technician can explain the effect of oxidation on electrical connections as well as on an automotive finish.

SC217 Describes/Explains Electromagnetism Magnetic Fields/Force
- The technician can explain the effect of magnetic fields on unshielded circuits and voltages induced in other circuits by the magnetic fields.

SC236 Describes/Explains Energy Momentum
- The technician can explain how energy is dissipated through the body based on the momentum of the vehicle at the time of the impact.

SC248 Describes/Explains Force
- The technician can explain the principles of force as it applies to the realignment of a component.

SC253 Describes/Explains Force Inertia
- The technician can explain how the rate of a force in motion can impact on an automobile body.

SC255 Describes/Explains Force Pressure
- The technician can demonstrate an understanding of the concept of pressure in relation to the concept of force.

SC274 Describes/Explains Heat Conduction/Convection
- The technician is able to explain the concept of heat transfer in terms of conduction, radiation, and convection in various automotive systems.

SC277 Describes/Explains Heat Expansion/Contraction
- The technician is able to demonstrate an understanding of the expansion and contraction of various system parts as a result of heat generated during the use and cooling of the system when not in operation.

SC278 Describes/Explains Heat Fusion/Vaporization
- The technician can demonstrate an understanding of the effect of how adding heat causes a change in state of matter, such as from a solid to a liquid to a gas.

SC280 Describes/Explains Heat Insulation
- The technician can explain the role of insulation in maintaining stable temperatures or in preventing the transfer of heat to an unwanted area.

SC282 Describes/Explains Heat Temperature
- The technician can explain the differences between heat and temperature and demonstrate an understanding of how to measure each.

SC341 Describes/Explains Matter Phases/States
- The technician can explain in detail the three states of matter.

SC395 Describes/Explains Solutions Solvent
- The technician understands the use and safety requirements of all solvents used in an autobody environment.

SC399 Describes/Explains Sound Carriers/Insulators
- The technician can demonstrate an understanding of how sound generated in one place in the body and engine can be carried to other parts of the body or engine through metal and other materials.

SC404 Describes/Explains Sound Frequency-Hertz
- The technician is able to explain the relationship of the frequency of the sound to a normal or abnormally operating system.

SC406 Describes/Explains Sound Noise/Acoustics
- The technician is able to demonstrate an understanding of why a specific noise sounds different depending on the acoustics of the vehicle.

SC411 Describes/Explains Sound Resonance
- The technician can demonstrate an understanding of what happens when an object resonates.

SC443 Describes/Explains Weather/Climate Relative Humidity
- The technician can demonstrate an understanding of and discuss relative humidity in terms of effect on paint and substance applications.

SC447 Describes/Explains Work Levers
- The technician can explain how levers can be used to increase an applied force over distance.

SC448 Describes/Explains Work Pulleys
- The technician can explain how pulleys can be used to increase an applied force over distance.

SC467 Identifies Definitions Operational
- The technician is able to identify and define terms that specifically relate to systems, diagnosis, service, and repair.

SC489 Measures Distance/Length
- The technician uses precision measuring devices to determine if wear and adjustments are within the manufacturer's specifications, and to assure that replacement parts meet the manufacturer's specifications.

SC492 Measures Force
- The technician uses tension gauges such as a torque wrench to measure the force or tension required to tighten connections according to the manufacturer's specifications.

SC493 Measures Mass/Weight
- The technician uses a scale to measure component weight in order to mix an adhesive or to determine the strength and integrity of a component or part.

SC495 Measures Temperature Fahrenheit/Centigrade
- The technician uses direct and indirect methods to measure system temperatures and then converts them to Fahrenheit or Centigrade as required by the manufacturer for proper cure and application times.

SC496 Measures Time
- The technician uses direct and indirect methods to measure application times, mixing guidelines for certain products, and labor time guides for selected tasks.

SC497 Measures Volume Liquids/Solids
- The technician uses direct and indirect methods to measure the volume of liquids in a mixture for adhesion purposes.

SC499 Uses Computers Information Processing
- The technician uses computer databases for information retrieval and for input devices to process information for customers, billing purposes, warranty work, and other record-keeping purposes.

SC502 Measures Parameters Electrical
- The technician uses precision electrical test equipment to measure current, voltage, resistance, continuity, and/or power.

SC503 Describes/Explains Fluid System Hydraulics
- The technician can explain how an applied force at one location can be transmitted via fluid pressure to provide a force at a remote location such as in the brake system or with selected tools and equipment used to realign the automobile body and structure.

SC504 Describes/Explains Fluid System Pneumatics
- The technician can demonstrate an understanding of the physical properties in pneumatic systems, tools and equipment.

SC508 Describes/Explains Matter Metallurgy
- The technician can explain the criticality of metals with different hardness, depending on the function and location of the metal as well as how fillers and finishes adhere to metal.

SC511 Describes/Explains Matter Surface Process (Absorption/Adsorption)
- The technician can explain the surface process that occurs on system seals due to absorption of the contained materials.

SC513 Describes/Explains Force Torque
- The technician can demonstrate an understanding of how torque relates to force and angular acceleration.

SC514 Describes/Explains Electricity Semiconductor Devices
- The technician can demonstrate an understanding of the ability of semiconductor devices to rapidly modify component operational parameters depending on inputs from sensors such as for the air bag or AC system.

SC515 Describes/Explains Work Simple Machines
- The technician can demonstrate an understanding of how cams, pulleys, and levers are used to multiply force or transfer directions of force in a mechanical system.

SC518 Describes/Explains Electricity Mechanical Transducers
- The technician can demonstrate an understanding of the role mechanical transducers play in sending an electrical control signal to modify the system's operating characteristics.

SC522 Applies/Uses Ratio Proportion Mixtures
- The technician can correctly use proportions and ratios in mixing fillers, finishes, and other substances.

SC528 Describes/Explains Adhesives/Sealants
- The technician can demonstrate an understanding of how surface processes and cohesive/adhesive forces aid in glues, tapes, and sealants.

SC529 Identifies Physical Properties Glass/Polymers
- The technician can identify and use proper service procedures based on the physical properties of an automobile component or system that are made of glass or plastic.

SC531 Describes/Explains Viscosity
- The technician can explain fluid viscosity as a measurement and why it is important to the application of fillers, plastics, and finishes.

# II. NON-STRUCTURAL ANALYSIS AND DAMAGE REPAIR

## UNDUPLICATED LIST

### *LANGUAGE ARTS/COMMUNICATIONS SKILLS*

LA001 Adapts Diction/Structure
- The technician adapts diction and structure to the context of all verbal and written communication based on the audience, purpose, and specific situation.

LA005 Adapts Strategy Listening
- The technician adapts a listening strategy that will provide the information required for solving the problem.

LA006 Adapts Strategy Reading
- The technician adapts a reading strategy for all written materials, e.g. customer's notes, service manuals, shop manuals, technical bulletins, and computer/data feed readouts, etc., that will help identify the solution to the problem.

LA007 Adapts Strategy Speaking
- The technician adapts a communication strategy for the customer, supervisor, and fellow employees that will yield the highest quality usable information for problem solving.

LA008 Adapts Strategy Writing
- The technician adapts a writing strategy that is most appropriate for the intended audience (e.g. customers, supervisor, and fellow employees) when documenting repair information.

LA009 Adapts Style Purpose
- The technician adapts a style for speaking and writing that is consistent with the purpose of the communication format.

LA013 Applies/Uses Definitions
- The technician can apply industry definitions to solve problems in various components and systems of the automobile.

LA020 Applies/Uses Study Habits/Methods
- The technician uses study habits and methods when consulting the manufacturer's publications, e.g. shop manuals, references, and computer databases.

LA022 Applies/Uses Study Habits/Methods Prior Knowledge
- The technician uses prior knowledge of similar situations to determine the specific cause(s) of the problem.

LA023 Applies/Uses Study Habits/Methods Skimming/Scanning
- The technician will visually skim or scan the manufacturer's service manuals or databases to identify information that is related to any unfamiliar system under review, then study the applicable information with the intensity necessary for the situation.

LA035 Attends Directions/Task
- The technician attends to all written and oral directions that relate to the task or system under study.

LA036 Attends Nonverbal Cues
- The technician attends to nonverbal cues in discussions with customers and associates to verify, identify, and solve problems.

LA037 Attends Verbal Cues
- The technician attends to verbal cues in discussions with customers and associates to verify, identify, and solve problems.

LA038 Collects/Organizes Information-Oral/Written
- The technician collects and organizes oral and written information based on discussions, notes, observations, personal experiences, and data collection that will assist in the problem analysis and solution process.

LA069 Composes/Edits Notes
- The technician makes notes regarding symptoms, possible causes of problems, and other data that will aid in the diagnosis and problem solving process.

LA074 Composes/Edits Paragraphs
- The technician composes complete and accurate paragraphs that include information regarding symptoms, diagnosis results, and appropriate details when preparing warranty claims and information for inclusion on work orders.

LA098 Composes/Edits Reports Summaries
- The technician uses appropriate grammar and sentence structure when summarizing problems and actions taken in reports.

LA099 Composes/Edits Sentences
- The technician uses conventional sentence structure, spelling, capitalization, and punctuation when composing sentences for warranty reports.

LA121 Comprehends Information-Oral
- The technician can comprehend information gathered during discussions with customers, supervisors, and associates regarding problem symptoms and potential solutions.

LA132 Comprehends Information-Written
- The technician can comprehend and apply available written information needed to diagnose, analyze, and solve problems.

LA134 Comprehends Information-Written Cause/Effect Relationships
- The technician comprehends and uses cause and effect relationships presented in service manual problem solving trees to diagnose faults in a component or system.

LA136 Comprehends Information-Written Charts/Tables/Graphs
- The technician consults charts, tables, or graphs to determine the manufacturer's specifications for component or system alignment.

LA147 Comprehends Information-Written Sequence
- The technician consults written information to determine the applicable technical sequence required for solving a specific problem.

LA167 Evaluates Information-Oral
- The technician can evaluate the usefulness of oral information provided by customers or associates when analyzing a problem.

LA180 Evaluates Information-Written
- The technician evaluates the usefulness of available written information for clarity and adequacy when analyzing a problem.

LA215 Identifies Information-Written Abbreviations/Acronyms
- The technician can identify and use written abbreviations and acronyms in diagnosis and problem solving.

LA231 Identifies Purpose/Strategy Listening/Reading/Speaking/Writing
- The technician identifies both purpose and effective strategies for listening, reading, speaking, and writing when dealing with customers, associates, and supervisors.

LA236 Infers/Predicts Information-Oral
- The technician makes inferences and recommends solutions to problems based on discussions with customers, associates and supervisors.

LA247 Infers/Predicts Information-Written
- The technician makes inferences and predicts the solution to the problem from the information provided on the work order.

LA266 Presents Informal Speech Information Requests
- The technician requests specific information relative to the symptoms of the problem from the customer, and possible solutions to the problem from associates and supervisors.

LA267 Presents Informal Speech Information Supplying
- The technician supplies clarifying information to customers, associates, the parts supplier, and the supervisor.

LA271 Uses Dictionary
-The technician refers to the dictionary to define terms or to check spelling.

LA278 Uses Text Resources
- The technician uses text resources such as glossaries of terms, service manual indexes, database menus, and tables of contents to gather data for diagnosis and repair.

LA283 Uses Media Resources Databases
- The technician uses computerized and other databases to obtain system information.

LA285 Comprehends Information-Written . Operator's Manual
- The technician can comprehend and apply information in the operator's manuals to operate and maintain automotive and autobody tools and equipment.

LA286 Uses Text Resources Service (Shop) Manual
- The technician uses the service manual, in both database and hard copy formats, to identify the manufacturer's specifications for system operation, component specifications, and formulas for mixing various compounds.

## *MATH SKILLS*

MA013 Calculates/Evaluates Mean/Median/Mode

- The technician can calculate the average (mean) of several different measurements to determine any variance from the manufacturer's specifications.

MA026 Computes Addition Decimals

- The technician can add numbers that include decimals to determine conformance with the manufacturer's specifications.

MA028 Computes Addition Mentally

- The technician can mentally add two or more numbers to determine conformance with the manufacturer's specifications.

MA034 Computes Addition Whole Numbers

- The technician can add whole numbers to accurately determine measurement conformance with the manufacturer's specifications.

MA039 Computes Division Decimals

- The technician can divide decimals to determine measurement conformance with the manufacturer's specifications.

MA047 Computes Division Whole Numbers

- The technician can divide whole numbers to determine differences for comparison with the manufacturer's specifications.

MA065 Computes Multiplication Decimals

- The technician can multiply numbers that include decimals to determine conformance with the manufacturer's specifications.

MA067 Computes Multiplication Mentally

- The technician can mentally multiply numbers that include decimals to determine conformance with the manufacturer's specifications.

MA073 Computes Subtraction Whole Numbers

- The technician can subtract whole numbers to determine differences for comparison with the manufacturer's specifications.

MA084 Computes Subtraction Decimals

- The technician can subtract numbers that include decimals to determine conformance with the manufacturer's specifications.

MA086 Computes Subtraction Mentally

- The technician can mentally subtract numbers to arrive at a difference for comparison with the manufacturer's specifications.

MA092 Computes Subtraction Whole Numbers

- The technician can subtract whole numbers to determine differences for comparison with the manufacturer's specifications.

MA126 Converts Units English/Metric -- Feet/Meters, e.g.

- The technician can measure/test with tools designed for English or metric measurements and then convert the resulting measurement to the system used by the manufacturers for specifying the correct measurement or tolerance.

MA140 Estimates/Rounds Expected Outcomes Everyday Occurrences
- The technician estimates the anticipated performance outcome of a normally operating system as well as the expected outcome of everyday occurrences such as the result of a body parameter being out of conformance with the manufacturer's specifications.

MA146 Estimates/Rounds Numbers Add/Subtract/Divide/Multiply
- The technician can estimate the results of basic arithmetic operations, and can accurately round up or down depending on the appropriate rule for the situation.

MA153 Formulates/Verifies Angles
- The technician can visually formulate an angle (e.g. body component alignment) and verify its conformance to the manufacturer's specified angle.

MA161 Identifies English Measures Length/Volume/Weight
- The technician can determine the degree of conformance to the manufacturer's specifications for length, volume and any other appropriate measurements in the English system.

MA168 Identifies Lines Parallel/Perpendicular
- The technician can use measurement devices to determine the parallelism or perpendicularity of chassis, suspension, and other vehicle dimension requiring geometric alignment principles.

MA170 Identifies Lines Vertical/Horizontal
- The technician must be very skilled in determining if the lines of an automobile are vertical or horizontal as specified in the original design specifications.

MA171 Identifies Metric Measures Length/Volume/Weight
- The technician can determine the degree of conformance to the manufacturer's specifications for length, volume and other appropriate measurements using the metric system.

MA174 Interprets Charts/Tables/Graphs
- The technician can interpret charts, tables, or graphs to determine the manufacturer's specifications for a given system.

MA176 Interprets Symbols <, >, =, e.g.
- The technician interprets symbols to determine compliance with the manufacturer's specifications.

MA177 Interprets System of Numbers Place Value
- The technician is able to interpret place value (tenths, hundredths, thousandths) when conducting precision measurements.

MA180 Measures Direct Angles
- The technician can use angle measurement equipment and techniques to determine any vehicle angle measurement variance from the manufacturer's specifications.

MA181 Measures Direct Distance
- The technician can measure distance using a variety of devices to determine conformance to the manufacturer's tolerances and specifications.

MA183 Measures Direct Time
- The technician measures time which is very critical to proper mixing, application, and drying of certain adhesives, fillers, etc.

MA185 Measures Direct Weight
- The technician uses scales to determine whether the weight of a given component is in conformance with the manufacturer's specified weight.

MA186 Measures Indirect
- The technician can use various forms of indirect measurement to determine if components are in conformance with manufacturer's specifications.

MA190 Measures Metric Distance
- The technician can use metric measurement instruments to determine correct sizes or distances in the metric system.

MA192 Measures Metric Volume
- The technician can determine the volume of a vessel when the specifications are in liters.

MA242 Understands Definitions Standards
- The technician can use and conform to standards defined by each manufacturer for the system being analyzed.

MA244 Understands Geometric Figures Visual Perception
- The technician can visually perceive the geometric relationships of systems and sub-systems requiring alignment or verification.

MA245 Understands Line/Angle Relationships
- The technician understands the necessity of verifying that the relationship of parallel lines and angles concur with the manufacturer's specifications when diagnosing the alignment of a body component.

MA271 Determines Proper Operation
- The technician can determine the proper sequence of arithmetic operations to arrive at a solution when comparing system measurements to the manufacturer's specifications.

MA273 Computes Tolerances/Ranges Mentally
- When comparing the observed measurement to the manufacturer's specifications, the technician can mentally compute whether the observed measurement is out-of-tolerance.

MA274 Computes Proper Operations Mentally
- The technician can determine the proper mathematical operation (addition, multiplication, subtraction or division) and mentally arrive at a solution.

MA275 Identifies Temperatures Fahrenheit/Centigrade
- The technician can identify whether a temperature measurement should be made using a Fahrenheit or Centigrade measuring device.

## *SCIENCE SKILLS*

SC007 Analyzes/Evaluates Environmental Issues

- The technician develops and maintains an understanding of all federal, state, and local rules and regulations regarding environmental issues related to the work of the autobody technician. The technician uses such things as government impact statements, media information, and general knowledge of pollution and waste management to correctly use and dispose of products that result from the performance of a repair task.

SC012 Analyzes/Evaluates Environmental Issues Waste Management

- The technician evaluates the waste products resulting from an automobile body repair task and handles the disposal of materials in accordance with applicable federal, state, and local rules and regulations.

SC041 Applies/Uses Laboratory Techniques Safety

- The technician follows all safety regulations and applicable procedures while performing the task.

SC042 Applies/Uses Maps/Charts/Tables/Graphs

- The technician uses the information in service manual charts, tables, or graphs to determine the manufacturer's specifications for components and the appropriate repair/replacement procedure and/or part.

SC044 Applies/Uses Scientific Methods

- The technician develops a theory relative to the cause of the problem based on the information provided, then tests the hypothesis to determine the solution. Major steps include: ① identify the problem; ② gather information; ③ develop hypothesis; ④ take action; ⑤ check results.

SC052 Converts Measurement Units English/Metric

- The technician can convert measurements taken in the English or metric system to specifications stated in terms of either system.

SC114 Describes/Explains Chemical Reactions

- The technician can demonstrate an understanding of the chemical reaction that occurs in various substances used in the automobile.

SC116 Describes/Explains Chemical Reactions Catalysts

- The technician can explain the role a catalyst plays in the mixing of fillers or finishes for use on the automobile body.

SC121 Describes/Explains Chemical Reactions Inhibitors

- The technician can explain the purpose of adding additives to an autobody repair compound.

SC177 Describes/Explains Electricity

- The technician can demonstrate an understanding of and explain the properties of electricity that impact the lighting, engine management, and other electrical systems of a vehicle.

SC178 Describes/Explains Batteries

- The technician can demonstrate an understanding of the electrochemical reactions that occur in wet and dry cell batteries.

SC180 Describes/Explains Conductors

- The technician can explain the difference between electrical conductors and insulators.

SC184 Describes/Explains Electricity Ground

- The technician can demonstrate an understanding of the characteristics of a quality electrical ground and the problems associated with having an electrical circuit that is inadequately grounded.

SC187 Describes/Explains Electricity Short Circuit
- The technician can demonstrate an understanding of the processes used to locate a short circuit in the electrical/electronic system.

SC199 Describes/Explains Electricity - Measurement Ammeter/Voltmeter
- The technician can demonstrate an understanding of how to correctly measure electrical current and voltage in a circuit.

SC201 Describes/Explains Electricity - Measurement Fuse
- The technician can demonstrate an understanding of and explain the role of a fuse or fusible link when used as a protective device in an electrical or electronic circuit.

SC204 Describes/Explains Electricity - Measurement Resistance
- The technician can demonstrate an understanding of the relationship of resistance to heat, voltage drop, and circuit parameters.

SC205 Describes/Explains Electricity - Measurement Voltage
- The technician can demonstrate an understanding of and explain system voltage generation, uses, and characteristics.

SC212 Describes/Explains Electrochemical Reactions Activity of Metals
- The technician can explain the conductivity problems in a circuit when connectors corrode due to electrochemical reactions.

SC213 Describes/Explains Electrochemical Reactions Oxidation/Reduction
- The technician can explain the effect of oxidation on electrical connections as well as on an automotive finish.

SC217 Describes/Explains Electromagnetism Magnetic Fields/Force
- The technician can explain the effect of magnetic fields on unshielded circuits and voltages induced in other circuits by the magnetic fields.

SC236 Describes/Explains Energy Momentum
- The technician can explain how energy is dissipated through the body based on the momentum of the vehicle at the time of the impact.

SC249 Describes/Explains Energy Force, Balanced/Unbalanced
- The technician can demonstrate an understanding of the role of balanced and unbalanced forces on linear or rotating vehicle assemblies.

SC253 Describes/Explains Force Inertia
- The technician can explain how the rate of a force in motion can impact on an automobile body.

SC255 Describes/Explains Force Pressure
- The technician can demonstrate an understanding of the concept of pressure in relation to the concept of force.

SC274 Describes/Explains Heat Conduction/Convection
- The technician is able to explain the concept of heat transfer in terms of conduction, radiation, and convection in various automotive systems.

SC277 Describes/Explains Heat Expansion/Contraction
- The technician is able to demonstrate an understanding of the expansion and contraction of various system parts as a result of heat generated during the use and cooling of the system when not in operation.

SC278 Describes/Explains Heat Fusion/Vaporization
- The technician can demonstrate an understanding of the effect of how adding heat causes a change in state of matter, such as from a solid to a liquid to a gas.

SC280 Describes/Explains Heat Insulation
- The technician can explain the role of insulation in maintaining stable temperatures or in preventing the transfer of heat to an unwanted area.

SC282 Describes/Explains Heat Temperature
- The technician can explain the differences between heat and temperature and demonstrate an understanding of how to measure each.

SC338 Describes/Explains Matter Density/Specific Gravity
- The technician can explain the need for a specific gravity test of battery electrolyte to determine charge.

SC341 Describes/Explains Matter Phases/States
- The technician can explain in detail the three states of matter.

SC395 Describes/Explains Solutions Solvent
- The technician understands the use and safety requirements of all solvents used in an autobody environment.

SC399 Describes/Explains Sound Carriers/Insulators
- The technician can demonstrate an understanding of how sound generated in one place in the body and engine can be carried to other parts of the body or engine through metal and other materials.

SC404 Describes/Explains Sound Frequency-Hertz
- The technician is able to explain the relationship of the frequency of the sound to a normal or abnormally operating system.

SC406 Describes/Explains Sound Noise/Acoustics
- The technician is able to demonstrate an understanding of why a specific noise sounds different depending on the acoustics of the vehicle.

SC411 Describes/Explains Sound Resonance
- The technician can demonstrate an understanding of what happens when an object resonates.

SC443 Describes/Explains Weather/Climate Relative Humidity
- The technician can demonstrate an understanding of and discuss relative humidity in terms of effect on paint and substance applications.

SC467 Identifies Definitions Operational
- The technician is able to identify and define terms that specifically relate to systems, diagnosis, service, and repair.

SC489 Measures Distance/Length
- The technician uses precision measuring devices to determine if wear and adjustments are within the manufacturer's specifications, and to assure that replacement parts meet the manufacturer's specifications.

SC492 Measures Force
- The technician uses tension gauges such as a torque wrench to measure the force or tension required to tighten connections according to the manufacturer's specifications.

SC493 Measures Mass/Weight

- The technician uses a scale to measure component weight in order to mix an adhesive or to determine the strength and integrity of a component or part.

SC495 Measures Temperature Fahrenheit/Centigrade

- The technician uses direct and indirect methods to measure system temperatures and then converts them to Fahrenheit or Centigrade as required by the manufacturer for proper cure and application times.

SC496 Measures Time

- The technician uses direct and indirect methods to measure application times, mixing guidelines for certain products, and labor time guides for selected tasks.

SC497 Measures Volume Liquids/Solids

- The technician uses direct and indirect methods to measure the volume of liquids in a mixture for adhesion purposes.

SC499 Uses Computers Information Processing

- The technician uses computer databases for information retrieval and for input devices to process information for customers, billing purposes, warranty work, and other record-keeping purposes.

SC502 Measures Parameters Electrical

- The technician uses precision electrical test equipment to measure current, voltage, resistance, continuity, and/or power.

SC503 Describes/Explains Fluid System Hydraulics

- The technician can explain how an applied force at one location can be transmitted via fluid pressure to provide a force at a remote location such as in the brake system or with selected tools and equipment used to realign the automobile body and structure.

SC504 Describes/Explains Fluid System Pneumatics

- The technician can demonstrate an understanding of the physical properties in pneumatic systems, tools and equipment.

SC508 Describes/Explains Matter Metallurgy

- The technician can explain the criticality of metals with different hardness, depending on the function and location of the metal as well as how fillers and finishes adhere to metal.

SC511 Describes/Explains Matter Surface Process (Absorption/Adsorption)

- The technician can explain the surface process that occurs on system seals due to absorption of the contained materials.

SC513 Describes/Explains Force Torque

- The technician can demonstrate an understanding of how torque relates to force and angular acceleration.

SC514 Describes/Explains Electricity Semiconductor Devices

- The technician can demonstrate an understanding of the ability of semiconductor devices to rapidly modify component operational parameters depending on inputs from sensors such as for the air bag or AC system.

SC515 Describes/Explains Work Simple Machines

- The technician can demonstrate an understanding of how cams, pulleys, and levers are used to multiply force or transfer directions of force in a mechanical system.

SC518 Describes/Explains Electricity Mechanical Transducers
- The technician can demonstrate an understanding of the role mechanical transducers play in sending an electrical control signal to modify the system's operating characteristics.

SC522 Applies/Uses Ratio Proportion Mixtures
- The technician can correctly use proportions and ratios in mixing fillers, finishes, and other substances.

SC528 Describes/Explains Adhesives/Sealants
- The technician can demonstrate an understanding of how surface processes and cohesive/adhesive forces aid in glues, tapes, and sealants.

SC529 Identifies Physical Properties Glass/Polymers
- The technician can identify and use proper service procedures based on the physical properties of an automobile component or system that are made of glass or plastic.

SC530 Describes/Explains Chemical Reactions Activators
- The technician can describe or explain the role that activators have in causing a change in the chemical state of a compound or filler.

SC531 Describes/Explains Viscosity
- The technician can explain fluid viscosity as a measurement and why it is important to the application of fillers, plastics, and finishes.

# III. MECHANICAL AND ELECTRICAL COMPONENTS

## UNDUPLICATED LIST

### *LANGUAGE ARTS/COMMUNICATIONS SKILLS*

LA001 Adapts Diction/Structure
- The technician adapts diction and structure to the context of all verbal and written communication based on the audience, purpose, and specific situation.

LA005 Adapts Strategy Listening
- The technician adapts a listening strategy that will provide the information required for solving the problem.

LA006 Adapts Strategy Reading
- The technician adapts a reading strategy for all written materials, e.g. customer's notes, service manuals, shop manuals, technical bulletins, and computer/data feed readouts, etc., that will help identify the solution to the problem.

LA007 Adapts Strategy Speaking
- The technician adapts a communication strategy for the customer, supervisor, and fellow employees that will yield the highest quality usable information for problem solving.

LA008 Adapts Strategy Writing
- The technician adapts a writing strategy that is most appropriate for the intended audience (e.g. customers, supervisor, and fellow employees) when documenting repair information.

LA009 Adapts Style Purpose
- The technician adapts a style for speaking and writing that is consistent with the purpose of the communication format.

LA013 Applies/Uses Definitions
- The technician can apply industry definitions to solve problems in various components and systems of the automobile.

LA020 Applies/Uses Study Habits/Methods
- The technician uses study habits and methods when consulting the manufacturer's publications, e.g. shop manuals, references, and computer databases.

LA022 Applies/Uses Study Habits/Methods Prior Knowledge
- The technician uses prior knowledge of similar situations to determine the specific cause(s) of the problem.

LA023 Applies/Uses Study Habits/Methods Skimming/Scanning
- The technician will visually skim or scan the manufacturer's service manuals or databases to identify information that is related to any unfamiliar system under review, then study the applicable information with the intensity necessary for the situation.

LA035 Attends Directions/Task
- The technician attends to all written and oral directions that relate to the task or system under study.

LA036 Attends Nonverbal Cues
- The technician attends to nonverbal cues in discussions with customers and associates to verify, identify, and solve problems.

LA037 Attends Verbal Cues
- The technician attends to verbal cues in discussions with customers and associates to verify, identify, and solve problems.

LA038 Collects/Organizes Information-Oral/Written
- The technician collects and organizes oral and written information based on discussions, notes, observations, personal experiences, and data collection that will assist in the problem analysis and solution process.

LA069 Composes/Edits Notes
- The technician makes notes regarding symptoms, possible causes of problems, and other data that will aid in the diagnosis and problem solving process.

LA074 Composes/Edits Paragraphs
- The technician composes complete and accurate paragraphs that include information regarding symptoms, diagnosis results, and appropriate details when preparing warranty claims and information for inclusion on work orders.

LA098 Composes/Edits Reports Summaries
- The technician uses appropriate grammar and sentence structure when summarizing problems and actions taken in reports.

LA099 Composes/Edits Sentences
- The technician uses conventional sentence structure, spelling, capitalization, and punctuation when composing sentences for warranty reports.

LA121 Comprehends Information-Oral
- The technician can comprehend information gathered during discussions with customers, supervisors, and associates regarding problem symptoms and potential solutions.

LA132 Comprehends Information-Written
- The technician can comprehend and apply available written information needed to diagnose, analyze, and solve problems.

LA134 Comprehends Information-Written Cause/Effect Relationships
- The technician comprehends and uses cause and effect relationships presented in service manual problem solving trees to diagnose faults in a component or system.

LA136 Comprehends Information-Written Charts/Tables/Graphs
- The technician consults charts, tables, or graphs to determine the manufacturer's specifications for component or system alignment.

LA147 Comprehends Information-Written Sequence
- The technician consults written information to determine the applicable technical sequence required for solving a specific problem.

LA167 Evaluates Information-Oral
- The technician can evaluate the usefulness of oral information provided by customers or associates when analyzing a problem.

LA180 Evaluates Information-Written
- The technician evaluates the usefulness of available written information for clarity and adequacy when analyzing a problem.

LA215 Identifies Information-Written Abbreviations/Acronyms
- The technician can identify and use written abbreviations and acronyms in diagnosis and problem solving.

LA231 Identifies Purpose/Strategy Listening/Reading/Speaking/Writing
- The technician identifies both purpose and effective strategies for listening, reading, speaking, and writing when dealing with customers, associates, and supervisors.

LA236 Infers/Predicts Information-Oral
- The technician makes inferences and recommends solutions to problems based on discussions with customers, associates and supervisors.

LA247 Infers/Predicts Information-Written
- The technician makes inferences and predicts the solution to the problem from the information provided on the work order.

LA266 Presents Informal Speech Information Requests
- The technician requests specific information relative to the symptoms of the problem from the customer, and possible solutions to the problem from associates and supervisors.

LA267 Presents Informal Speech Information Supplying
- The technician supplies clarifying information to customers, associates, the parts supplier, and the supervisor.

LA271 Uses Dictionary
-The technician refers to the dictionary to define terms or to check spelling.

LA278 Uses Text Resources
- The technician uses text resources such as glossaries of terms, service manual indexes, database menus, and tables of contents to gather data for diagnosis and repair.

LA283 Uses Media Resources Databases
- The technician uses computerized and other databases to obtain system information.

LA285 Comprehends Information-Written Operator's Manual
- The technician can comprehend and apply information in the operator's manuals to operate and maintain automotive and autobody tools and equipment.

LA286 Uses Text Resources Service (Shop) Manual
- The technician uses the service manual, in both database and hard copy formats, to identify the manufacturer's specifications for system operation, component specifications, and formulas for mixing various compounds.

## *MATH SKILLS*

MA001 Calculates/Evaluates Algebraic Expressions
- The technician can use Ohm's Law to determine electrical circuit parameters that are out-of-tolerance.

MA013 Calculates/Evaluates Mean/Median/Mode
- The technician can calculate the average (mean) of several different measurements to determine any variance from the manufacturer's specifications.

MA014 Calculates/Evaluates Measurement Precision
- The technician uses a variety of techniques to determine if selected measurements are precise and in congruence with manufacturer's specifications.

MA026 Computes Addition Decimals
- The technician can add numbers that include decimals to determine conformance with the manufacturer's specifications.

MA028 Computes Addition Mentally
- The technician can mentally add two or more numbers to determine conformance with the manufacturer's specifications.

MA034 Computes Addition Whole Numbers
- The technician can add whole numbers to accurately determine measurement conformance with the manufacturer's specifications.

MA039 Computes Division Decimals
- The technician can divide decimals to determine measurement conformance with the manufacturer's specifications.

MA047 Computes Division Whole Numbers
- The technician can divide whole numbers to determine differences for comparison with the manufacturer's specifications.

MA065 Computes Multiplication Decimals
- The technician can multiply numbers that include decimals to determine conformance with the manufacturer's specifications.

MA067 Computes Multiplication Mentally
- The technician can mentally multiply numbers that include decimals to determine conformance with the manufacturer's specifications.

MA073 Computes Subtraction Whole Numbers
- The technician can subtract whole numbers to determine differences for comparison with the manufacturer's specifications.

MA084 Computes Subtraction Decimals
- The technician can subtract numbers that include decimals to determine conformance with the manufacturer's specifications.

MA086 Computes Subtraction Mentally
- The technician can mentally subtract numbers to arrive at a difference for comparison with the manufacturer's specifications.

MA092 Computes Subtraction Whole Numbers
- The technician can subtract whole numbers to determine differences for comparison with the manufacturer's specifications.

MA126 Converts Units English/Metric -- Feet/Meters, e.g.
- The technician can measure/test with tools designed for English or metric measurements and then convert the resulting measurement to the system used by the manufacturers for specifying the correct measurement or tolerance.

MA128 Distinguishes Angles/Circles/Arcs
- The technician must be highly skilled in determining if certain angles, circles, or arcs have the proper shape and relationship after an impact has distorted or misaligned them.

MA129 Distinguishes Congruence/Similarity Geometric Figures
- The technician can distinguish whether or not the angle between related parts (e.g. body or suspension components) is within the manufacturer's specifications.

MA131 Distinguishes Equal/Not Equal
- The technician can distinguish when a measurement or tolerance is not equal to the manufacturer's specification.

MA140 Estimates/Rounds Expected Outcomes Everyday Occurrences
- The technician estimates the anticipated performance outcome of a normally operating system as well as the expected outcome of everyday occurrences such as the result of a body parameter being out of conformance with the manufacturer's specifications.

MA153 Formulates/Verifies Angles
- The technician can visually formulate an angle (e.g. suspension system or body component alignment) and verify its conformance to the manufacturer's specified angle.

MA161 Identifies English Measures Length/Volume/Weight
- The technician can determine the degree of conformance to the manufacturer's specifications for length, volume and any other appropriate measurements in the English system.

MA168 Identifies Lines Parallel/Perpendicular
- The technician can use measurement devices to determine the parallelism or perpendicularity of chassis, suspension, and other vehicle dimension requiring geometric alignment principles.

MA170 Identifies Lines Vertical/Horizontal
- The technician must be very skilled in determining if the lines of an automobile are vertical or horizontal as specified in the original design specifications.

MA171 Identifies Metric Measures Length/Volume/Weight
- The technician can determine the degree of conformance to the manufacturer's specifications for length, volume and other appropriate measurements using the metric system.

MA174 Interprets Charts/Tables/Graphs
- The technician can interpret charts, tables, or graphs to determine the manufacturer's specifications for a given system.

MA176 Interprets Symbols <, >, =, e.g.
- The technician interprets symbols to determine compliance with the manufacturer's specifications.

MA177 Interprets System of Numbers Place Value
- The technician is able to interpret place value (tenths, hundredths, thousandths) when conducting precision measurements.

MA180 Measures Direct Angles
- The technician can use angle measurement equipment and techniques to determine any vehicle angle measurement variance from the manufacturer's specifications.

MA181 Measures Direct Distance
- The technician can measure distance using a variety of devices to determine conformance to the manufacturer's tolerances and specifications.

MA184 Measures Direct Volume
- The technician can use various measurements to determine the volume of finishing and filler compounds to be applied or mixed.

MA186 Measures Indirect
- The technician can use various forms of indirect measurement to determine if components are in conformance with manufacturer's specifications.

MA190 Measures Metric Distance
- The technician can use metric measurement instruments to determine correct sizes or distances in the metric system.

MA229 Solves Problems Generates Conclusions Deductive Reasoning
- The technician can identify the specific cause of the described problem by generating conclusions based on known symptoms related to the problem.

MA239 Understands Conditionals
- The technician understands that if the described problem has certain conditions (symptoms), then there are a limited number of probable solutions to the problem.

MA242 Understands Definitions Standards
- The technician can use and conform to standards defined by each manufacturer for the system being analyzed.

MA244 Understands Geometric Figures Visual Perception
- The technician can visually perceive the geometric relationships of systems and sub-systems requiring alignment or verification.

MA245 Understands Line/Angle Relationships
- The technician understands the necessity of verifying that the relationship of parallel lines and angles concur with the manufacturer's specifications when diagnosing the alignment of a body component or steering and suspension system.

MA271 Determines Proper Operation
- The technician can determine the proper sequence of arithmetic operations to arrive at a solution when comparing system measurements to the manufacturer's specifications.

MA273 Computes Tolerances/Ranges Mentally

- When comparing the observed measurement to the manufacturer's specifications, the technician can mentally compute whether the observed measurement is out-of-tolerance.

MA274 Computes Proper Operations Mentally

- The technician can determine the proper mathematical operation (addition, multiplication, subtraction or division) and mentally arrive at a solution.

## *SCIENCE SKILLS*

SC007 Analyzes/Evaluates Environmental Issues

- The technician develops and maintains an understanding of all federal, state, and local rules and regulations regarding environmental issues related to the work of the autobody technician. The technician uses such things as government impact statements, media information, and general knowledge of pollution and waste management to correctly use and dispose of products that result from the performance of a repair task.

SC012 Analyzes/Evaluates Environmental Issues Waste Management

- The technician evaluates the waste products resulting from an automobile body repair task and handles the disposal of materials in accordance with applicable federal, state, and local rules and regulations.

SC041 Applies/Uses Laboratory Techniques Safety

- The technician follows all safety regulations and applicable procedures while performing the task.

SC042 Applies/Uses Maps/Charts/Tables/Graphs

- The technician uses the information in service manual charts, tables, or graphs to determine the manufacturer's specifications for components and the appropriate repair/replacement procedure and/or part.

SC044 Applies/Uses Scientific Methods

- The technician develops a theory relative to the cause of the problem based on the information provided, then tests the hypothesis to determine the solution. Major steps include: ① identify the problem; ② gather information; ③ develop hypothesis; ④ take action; ⑤ check results.

SC052 Converts Measurement Units English/Metric

- The technician can convert measurements taken in the English or metric system to specifications stated in terms of either system.

SC177 Describes/Explains Electricity

- The technician can demonstrate an understanding of and explain the properties of electricity that impact the lighting, engine management, and other electrical systems of a vehicle.

SC178 Describes/Explains Batteries

- The technician can demonstrate an understanding of the electrochemical reactions that occur in wet and dry cell batteries.

SC180 Describes/Explains Conductors

- The technician can explain the difference between electrical conductors and insulators.

SC182 Describes/Explains Current AC-DC

- The technician can explain the difference between direct and alternating current.

SC184 Describes/Explains Electricity Ground

- The technician can demonstrate an understanding of the characteristics of a quality electrical ground and the problems associated with having an electrical circuit that is inadequately grounded.

SC186 Describes/Explains Electricity Parallel/Series Circuits

- The technician can explain current flow and voltage in both parallel and series circuits.

SC187 Describes/Explains Electricity Short Circuit

- The technician can demonstrate an understanding of the processes used to locate a short circuit in the electrical/electronic system.

SC194 Describes/Explains Electricity - Generating Motors
- The technician can demonstrate an understanding of the role of the generator in maintaining battery and system voltage.

SC197 Describes/Explains Electricity - Generating Transformers
- The technician can explain the ignition coil transformer's role in generating the high voltage required operate a component.

SC198 Describes/Explains Electricity - Measurement
- The technician can demonstrate an understanding of the correct procedure to measure the electrical parameters of voltage, current, resistance, or power.

SC199 Describes/Explains Electricity - Measurement Ammeter/Voltmeter
- The technician can demonstrate an understanding of how to correctly measure electrical current and voltage in a circuit.

SC201 Describes/Explains Electricity - Measurement Fuse
- The technician can demonstrate an understanding of and explain the role of a fuse or fusible link when used as a protective device in an electrical or electronic circuit.

SC204 Describes/Explains Electricity - Measurement Resistance
- The technician can demonstrate an understanding of the relationship of resistance to heat, voltage drop, and circuit parameters.

SC205 Describes/Explains Electricity - Measurement Voltage
- The technician can demonstrate an understanding of and explain system voltage generation, uses, and characteristics.

SC212 Describes/Explains Electrochemical Reactions Activity of Metals
- The technician can explain the conductivity problems in a circuit when connectors corrode due to electrochemical reactions.

SC213 Describes/Explains Electrochemical Reactions Oxidation/Reduction
- The technician can explain the effect of oxidation on electrical connections as well as on an automotive finish.

SC217 Describes/Explains Electromagnetism Magnetic Fields/Force
- The technician can explain the effect of magnetic fields on unshielded circuits and voltages induced in other circuits by the magnetic fields.

SC236 Describes/Explains Energy Momentum
- The technician can explain how energy is dissipated through the body based on the momentum of the vehicle at the time of the impact.

SC249 Describes/Explains Energy Force, Balanced/Unbalanced
- The technician can demonstrate an understanding of the role of balanced and unbalanced forces on linear or rotating vehicle assemblies.

SC255 Describes/Explains Force Pressure
- The technician can demonstrate an understanding of the concept of pressure in relation to the concept of force.

SC274 Describes/Explains Heat Conduction/Convection

- The technician is able to explain the concept of heat transfer in terms of conduction, radiation, and convection in various automobile systems.

SC338 Describes/Explains Matter Density/Specific Gravity

- The technician can explain the need for a specific gravity test of battery electrolyte to determine charge.

SC399 Describes/Explains Sound Carriers/Insulators

- The technician can demonstrate an understanding of how sound generated in one place in the body and engine can be carried to other parts of the body or engine through metal and other materials.

SC404 Describes/Explains Sound Frequency-Hertz

- The technician is able to explain the relationship of the frequency of the sound to a normal or abnormally operating system.

SC406 Describes/Explains Sound Noise/Acoustics

- The technician is able to demonstrate an understanding of why a specific noise sounds different depending on the acoustics of the vehicle.

SC411 Describes/Explains Sound Resonance

- The technician can demonstrate an understanding of what happens when an object resonates.

SC467 Identifies Definitions Operational

- The technician is able to identify and define terms that specifically relate to systems, diagnosis, service, and repair.

SC489 Measures Distance/Length

- The technician uses precision measuring devices to determine if wear and adjustments are within the manufacturer's specifications, and to assure that replacement parts meet the manufacturer's specifications.

SC492 Measures Force

- The technician uses tension gauges such as a torque wrench to measure the force or tension required to tighten connections according to the manufacturer's specifications.

SC494 Measures Pressure

- The technician uses pressure measuring tools to determine pressures in hydraulic or pneumatic systems and compares them to the manufacturer's specifications.

SC495 Measures Temperature Fahrenheit/Centigrade

- The technician uses direct and indirect methods to measure system temperatures and then converts them to Fahrenheit or Centigrade as required by the manufacturer for proper cure and application times.

SC496 Measures Time

- The technician uses direct and indirect methods to measure time and compares the results to the manufacturer's specifications.

SC497 Measures Volume Liquids/Solids

- The technician uses direct and indirect methods to measure the volume of liquids in a mixture for adhesion purposes.

SC499 Uses Computers Information Processing

- The technician uses computer databases for information retrieval and for input devices to process information for customers, billing purposes, warranty work, and other record-keeping purposes.

SC502 Measures Parameters Electrical
- The technician uses precision electrical test equipment to measure current, voltage, resistance, continuity, and/or power.

SC503 Describes/Explains Fluid System Hydraulics
- The technician can explain how an applied force at one location can be transmitted via fluid pressure to provide a force at a remote location such as in the brake system or with selected tools and equipment used to realign the automobile body and structure.

SC504 Describes/Explains Fluid System Pneumatics
- The technician can demonstrate an understanding of the physical properties in pneumatic systems, tools and equipment.

SC507 Describes/Explains Motion Lubrication
- The technician can discuss the role of lubrication in relation to the concept of friction.

SC509 Describes/Explains Electricity Capacitance
- The technician can demonstrate an understanding of the role of capacitance in timer circuits, such as RC timers or a MAP sensor wherein the changing manifold pressure causes two metal discs to act like a capacitor, sending a varying voltage to the electronic component control system.

SC512 Describes/Explains Chemical Reactions Contamination
- The technician can demonstrate an understanding of how a contaminated liquid can cause a chemical reaction which can result in the deterioration of the finish or a plastic component.

SC513 Describes/Explains Force Torque
- The technician can demonstrate an understanding of how torque relates to force and angular acceleration.

SC514 Describes/Explains Electricity Semiconductor Devices
- The technician can demonstrate an understanding of the ability of semiconductor devices to rapidly modify component operational parameters depending on inputs from sensors such as for the air bag or AC system.

SC515 Describes/Explains Work Simple Machines
- The technician can demonstrate an understanding of how cams, pulleys, and levers are used to multiply force or transfer directions of force in a mechanical system.

SC516 Describes/Explains Motion Rotational
- The technician can explain how rotational motion can be changed to linear motion and why balance is important in these rotating systems.

SC517 Describes/Explains Electricity-Generating Generators
- The technician can demonstrate an understanding of the role generators play in the automobile system's operating characteristics.

SC518 Describes/Explains Electricity Mechanical Transducers
- The technician can demonstrate an understanding of the role mechanical transducers play in sending an electrical control signal to modify the system's operating characteristics.

SC529 Identifies Physical Properties Glass/Polymers

- The technician can identify and use proper service procedures based on the physical properties of an automobile component or system that are made of glass or plastic.

SC531 Describes/Explains Viscosity

- The technician can explain fluid viscosity as a measurement and why it is important to the application of fillers, plastics, and finishes.

# IV. PLASTIC REPAIR

## UNDUPLICATED LIST

### *LANGUAGE ARTS/COMMUNICATIONS SKILLS*

LA001 Adapts Diction/Structure
- The technician adapts diction and structure to the context of all verbal and written communication based on the audience, purpose, and specific situation.

LA005 Adapts Strategy Listening
- The technician adapts a listening strategy that will provide the information required for solving the problem.

LA006 Adapts Strategy Reading
- The technician adapts a reading strategy for all written materials, e.g. customer's notes, service manuals, shop manuals, technical bulletins, and computer/data feed readouts, etc., that will help identify the solution to the problem.

LA007 Adapts Strategy Speaking
- The technician adapts a communication strategy for the customer, supervisor, and fellow employees that will yield the highest quality usable information for problem solving.

LA008 Adapts Strategy Writing
- The technician adapts a writing strategy that is most appropriate for the intended audience (e.g. customers, supervisor, and fellow employees) when documenting repair information.

LA009 Adapts Style Purpose
- The technician adapts a style for speaking and writing that is consistent with the purpose of the communication format.

LA013 Applies/Uses Definitions
- The technician can apply industry definitions to solve problems in various components and systems of the automobile.

LA020 Applies/Uses Study Habits/Methods
- The technician uses study habits and methods when consulting the manufacturer's publications, e.g. shop manuals, references, and computer databases.

LA022 Applies/Uses Study Habits/Methods Prior Knowledge
- The technician uses prior knowledge of similar situations to determine the specific cause(s) of the problem.

LA023 Applies/Uses Study Habits/Methods Skimming/Scanning
- The technician will visually skim or scan the manufacturer's service manuals or databases to identify information that is related to any unfamiliar system under review, then study the applicable information with the intensity necessary for the situation.

LA035 Attends Directions/Task
- The technician attends to all written and oral directions that relate to the task or system under study.

LA036 Attends Nonverbal Cues
- The technician attends to nonverbal cues in discussions with customers and associates to verify, identify, and solve problems.

LA037 Attends Verbal Cues
- The technician attends to verbal cues in discussions with customers and associates to verify, identify, and solve problems.

LA038 Collects/Organizes Information-Oral/Written
- The technician collects and organizes oral and written information based on discussions, notes, observations, personal experiences, and data collection that will assist in the problem analysis and solution process.

LA069 Composes/Edits Notes
- The technician makes notes regarding symptoms, possible causes of problems, and other data that will aid in the diagnosis and problem solving process.

LA074 Composes/Edits Paragraphs
- The technician composes complete and accurate paragraphs that include information regarding symptoms, diagnosis results, and appropriate details when preparing warranty claims and information for inclusion on work orders.

LA098 Composes/Edits Reports Summaries
- The technician uses appropriate grammar and sentence structure when summarizing problems and actions taken in reports.

LA099 Composes/Edits Sentences
- The technician uses conventional sentence structure, spelling, capitalization, and punctuation when composing sentences for warranty reports.

LA121 Comprehends Information-Oral
- The technician can comprehend information gathered during discussions with customers, supervisors, and associates regarding problem symptoms and potential solutions.

LA132 Comprehends Information-Written
- The technician can comprehend and apply available written information needed to diagnose, analyze, and solve problems.

LA134 Comprehends Information-Written Cause/Effect Relationships
- The technician comprehends and uses cause and effect relationships presented in service manual problem solving trees to diagnose faults in a component or system.

LA136 Comprehends Information-Written Charts/Tables/Graphs
- The technician consults charts, tables, or graphs to determine the manufacturer's specifications for component or system alignment.

LA147 Comprehends Information-Written Sequence
- The technician consults written information to determine the applicable technical sequence required for solving a specific problem.

LA167 Evaluates Information-Oral
- The technician can evaluate the usefulness of oral information provided by customers or associates when analyzing a problem.

LA180 Evaluates Information-Written
- The technician evaluates the usefulness of available written information for clarity and adequacy when analyzing a problem.

LA215 Identifies Information-Written Abbreviations/Acronyms
- The technician can identify and use written abbreviations and acronyms in diagnosis and problem solving.

LA231 Identifies Purpose/Strategy Listening/Reading/Speaking/Writing
- The technician identifies both purpose and effective strategies for listening, reading, speaking, and writing when dealing with customers, associates, and supervisors.

LA236 Infers/Predicts Information-Oral
- The technician makes inferences and recommends solutions to problems based on discussions with customers, associates and supervisors.

LA247 Infers/Predicts Information-Written
- The technician makes inferences and predicts the solution to the problem from the information provided on the work order.

LA266 Presents Informal Speech Information Requests
- The technician requests specific information relative to the symptoms of the problem from the customer, and possible solutions to the problem from associates and supervisors.

LA267 Presents Informal Speech Information Supplying
- The technician supplies clarifying information to customers, associates, the parts supplier, and the supervisor.

LA271 Uses Dictionary
-The technician refers to the dictionary to define terms or to check spelling.

LA278 Uses Text Resources
- The technician uses text resources such as glossaries of terms, service manual indexes, database menus, and tables of contents to gather data for diagnosis and repair.

LA283 Uses Media Resources Databases
- The technician uses computerized and other databases to obtain system information.

LA285 Comprehends Information-Written Operator's Manual
- The technician can comprehend and apply information in the operator's manuals to operate and maintain automotive and autobody tools and equipment.

LA286 Uses Text Resources Service (Shop) Manual
- The technician uses the service manual, in both database and hard copy formats, to identify the manufacturer's specifications for system operation, component specifications, and formulas for mixing various compounds.

## MATH SKILLS

MA028 Computes Addition Mentally
- The technician can mentally add two or more numbers to determine conformance with the manufacturer's specifications.

MA034 Computes Addition Whole Numbers
- The technician can add whole numbers to accurately determine measurement conformance with the manufacturer's specifications.

MA039 Computes Division Decimals
- The technician can divide decimals to determine measurement conformance with the manufacturer's specifications.

MA047 Computes Division Whole Numbers
- The technician can divide whole numbers to determine differences for comparison with the manufacturer's specifications.

MA065 Computes Multiplication Decimals
- The technician can multiply numbers that include decimals to determine conformance with the manufacturer's specifications.

MA067 Computes Multiplication Mentally
- The technician can mentally multiply numbers that include decimals to determine conformance with the manufacturer's specifications.

MA073 Computes Subtraction Whole Numbers
- The technician can subtract whole numbers to determine differences for comparison with the manufacturer's specifications.

MA084 Computes Subtraction Decimals
- The technician can subtract numbers that include decimals to determine conformance with the manufacturer's specifications.

MA086 Computes Subtraction Mentally
- The technician can mentally subtract numbers to arrive at a difference for comparison with the manufacturer's specifications.

MA092 Computes Subtraction Whole Numbers
- The technician can subtract whole numbers to determine differences for comparison with the manufacturer's specifications.

MA126 Converts Units English/Metric -- Feet/Meters, e.g.
- The technician can measure/test with tools designed for English or metric measurements and then convert the resulting measurement to the system used by the manufacturers for specifying the correct measurement or tolerance.

MA153 Formulates/Verifies Angles
- The technician can visually formulate an angle (e.g. body component alignment) and verify its conformance to the manufacturer's specified angle.

MA161 Identifies English Measures Length/Volume/Weight
- The technician can determine the degree of conformance to the manufacturer's specifications for length, volume and any other appropriate measurements in the English system.

MA171 Identifies Metric Measures Length/Volume/Weight

- The technician can determine the degree of conformance to the manufacturer's specifications for length, volume and other appropriate measurements using the metric system.

MA174 Interprets Charts/Tables/Graphs

- The technician can interpret charts, tables, or graphs to determine the manufacturer's specifications for a given system.

MA176 Interprets Symbols <, >, =, e.g.

- The technician interprets symbols to determine compliance with the manufacturer's specifications.

MA177 Interprets System of Numbers Place Value

- The technician is able to interpret place value (tenths, hundredths, thousandths) when conducting precision measurements.

MA181 Measures Direct Distance

- The technician can measure distance using a variety of devices to determine conformance to the manufacturer's tolerances and specifications.

MA182 Measures Direct Temperature

- The technician can use appropriate temperature measurement tools to determine the existing temperature of ambient air and that of paints and inhibitors.

MA183 Measures Direct Time

- The technician needs to measure time which is very critical to proper mixing, application, and drying of certain finishes and substances.

MA186 Measures Indirect

- The technician can use various forms of indirect measurement to determine if components are in conformance with manufacturer's specifications.

MA190 Measures Metric Distance

- The technician can use metric measurement instruments to determine correct sizes or distances in the metric system.

MA192 Measures Metric Volume

- The technician can determine the volume of a vessel when the specifications are in liters.

MA242 Understands Definitions Standards

- The technician can use and conform to standards defined by each manufacturer for the system being analyzed.

MA245 Understands Line/Angle Relationships

- The technician understands the necessity of verifying that the relationship of parallel lines and angles concur with the manufacturer's specifications when diagnosing the alignment of a body component.

MA271 Determines Proper Operation

- The technician can determine the proper sequence of arithmetic operations to arrive at a solution when comparing system measurements to the manufacturer's specifications.

MA273 Computes Tolerances/Ranges Mentally

- When comparing the observed measurement to the manufacturer's specifications, the technician can mentally compute whether the observed measurement is out-of-tolerance.

MA274 Computes Proper Operations Mentally

- The technician can determine the proper mathematical operation (addition, multiplication, subtraction or division) and mentally arrive at a solution.

MA275 Identifies Temperatures Fahrenheit/Centigrade

- The technician can identify whether a temperature measurement should be made using a Fahrenheit or Centigrade measuring device.

## *SCIENCE SKILLS*

SC007 Analyzes/Evaluates Environmental Issues
- The technician develops and maintains an understanding of all federal, state, and local rules and regulations regarding environmental issues related to the work of the autobody technician. The technician uses such things as government impact statements, media information, and general knowledge of pollution and waste management to correctly use and dispose of products that result from the performance of a repair task.

SC012 Analyzes/Evaluates Environmental Issues Waste Management
- The technician evaluates the waste products resulting from an automobile body repair task and handles the disposal of materials in accordance with applicable federal, state, and local rules and regulations.

SC041 Applies/Uses Laboratory Techniques Safety
- The technician follows all safety regulations and applicable procedures while performing the task.

SC042 Applies/Uses Maps/Charts/Tables/Graphs
- The technician uses the information in service manual charts, tables, or graphs to determine the manufacturer's specifications for components and the appropriate repair/replacement procedure and/or part.

SC044 Applies/Uses Scientific Methods
- The technician develops a theory relative to the cause of the problem based on the information provided, then tests the hypothesis to determine the solution. Major steps include: ① identify the problem; ② gather information; ③ develop hypothesis; ④ take action; ⑤ check results.

SC052 Converts Measurement Units English/Metric
- The technician can convert measurements taken in the English or metric system to specifications stated in terms of either system.

SC114 Describes/Explains Chemical Reactions
- The technician can demonstrate an understanding of the chemical reaction that occurs in various substances used in the automobile.

SC116 Describes/Explains Chemical Reactions Catalysts
- The technician can explain the role a catalyst plays in the mixing of fillers or finishes for use on the automobile body.

SC121 Describes/Explains Chemical Reactions Inhibitors
- The technician can explain the purpose of adding additives to an autobody repair compound.

SC274 Describes/Explains Heat Conduction/Convection
- The technician is able to explain the concept of heat transfer in terms of conduction, radiation, and convection in various automotive systems.

SC277 Describes/Explains Heat Expansion/Contraction
- The technician is able to demonstrate an understanding of the expansion and contraction-of various system parts as a result of heat generated during the use and cooling of the system when not in operation.

SC278 Describes/Explains Heat Fusion/Vaporization
- The technician can demonstrate an understanding of the effect of how adding heat causes a change in state of matter, such as from a solid to a liquid to a gas.

SC280 Describes/Explains Heat Insulation
- The technician can explain the role of insulation in maintaining stable temperatures or in preventing the transfer of heat to an unwanted area.

SC282 Describes/Explains Heat Temperature
- The technician can explain the differences between heat and temperature and demonstrate an understanding of how to measure each.

SC341 Describes/Explains Matter Phases/States
- The technician can explain in detail the three states of matter.

SC395 Describes/Explains Solutions Solvent
- The technician understands the use and safety requirements of all solvents used in an autobody environment.

SC443 Describes/Explains Weather/Climate Relative Humidity
- The technician can demonstrate an understanding of and discuss relative humidity in terms of effect on paint and substance applications.

SC467 Identifies Definitions Operational
- The technician is able to identify and define terms that specifically relate to systems, diagnosis, service, and repair.

SC489 Measures Distance/Length
- The technician uses precision measuring devices to determine if wear and adjustments are within the manufacturer's specifications, and to assure that replacement parts meet the manufacturer's specifications.

SC492 Measures Force
- The technician uses tension gauges such as a torque wrench to measure the force or tension required to tighten connections according to the manufacturer's specifications.

SC495 Measures Temperature Fahrenheit/Centigrade
- The technician uses direct and indirect methods to measure system temperatures and then converts them to Fahrenheit or Centigrade as required by the manufacturer for proper cure and application times.

SC496 Measures Time
- The technician uses direct and indirect methods to measure application times, mixing guidelines for certain products, and labor time guides for selected tasks.

SC497 Measures Volume Liquids/Solids
- The technician uses direct and indirect methods to measure the volume of liquids in a mixture for adhesion purposes.

SC499 Uses Computers Information Processing
- The technician uses computer databases for information retrieval and for input devices to process information for customers, billing purposes, warranty work, and other record-keeping purposes.

SC504 Describes/Explains Fluid System Pneumatics
- The technician can demonstrate an understanding of the physical properties in pneumatic systems, tools and equipment.

SC511 Describes/Explains Matter Surface Process (Absorption/Adsorption)
- The technician can explain the surface process that occurs on system seals due to absorption of the contained materials.

SC513 Describes/Explains Force Torque
- The technician can demonstrate an understanding of how torque relates to force and angular acceleration.

**AIIM**

**Association for Information and Image Management**

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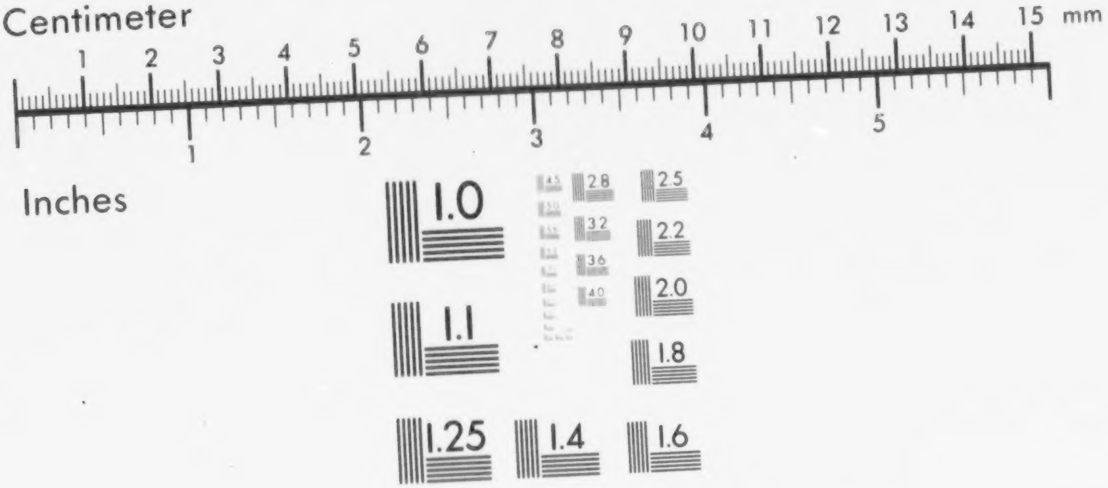
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2.2
2.5
2.8
3.2
3.6
4.0

MANUFACTURED TO AIIM STANDARDS
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SC522 Applies/Uses Ratio Proportion Mixtures
- The technician can correctly use proportions and ratios in mixing fillers, finishes, and other substances.

SC528 Describes/Explains Adhesives/Sealants
- The technician can demonstrate an understanding of how surface processes and cohesive/adhesive forces aid in glues, tapes, and sealants.

SC529 Identifies Physical Properties Glass/Polymers
- The technician can identify and use proper service procedures based on the physical properties of an automobile component or system that are made of glass or plastic.

SC530 Describes/Explains Chemical Reactions Activators
- The technician can describe or explain the role that activators have in causing a change in the chemical state of a compound or filler.

SC531 Describes/Explains Viscosity
- The technician can explain fluid viscosity as a measurement and why it is important to the application of fillers, plastics, and finishes.

# V. PAINTING AND REFINISHING

UNDUPLICATED LIST

## *LANGUAGE ARTS/COMMUNICATIONS SKILLS*

LA001 Adapts Diction/Structure

- The technician adapts diction and structure to the context of all verbal and written communication based on the audience, purpose, and specific situation.

LA005 Adapts Strategy Listening

- The technician adapts a listening strategy that will provide the information required for solving the problem.

LA006 Adapts Strategy Reading

- The technician adapts a reading strategy for all written materials, e.g. customer's notes, service manuals, shop manuals, technical bulletins, and computer/data feed readouts, etc., that will help identify the solution to the problem.

LA007 Adapts Strategy Speaking

- The technician adapts a communication strategy for the customer, supervisor, and fellow employees that will yield the highest quality usable information for problem solving.

LA008 Adapts Strategy Writing

- The technician adapts a writing strategy that is most appropriate for the intended audience (e.g. customers, supervisor, and fellow employees) when documenting repair information.

LA009 Adapts Style Purpose

- The technician adapts a style for speaking and writing that is consistent with the purpose of the communication format.

LA013 Applies/Uses Definitions

- The technician can apply industry definitions to solve problems in various components and systems of the automobile.

LA020 Applies/Uses Study Habits/Methods

- The technician uses study habits and methods when consulting the manufacturer's publications, e.g. shop manuals, references, and computer databases.

LA022 Applies/Uses Study Habits/Methods Prior Knowledge

- The technician uses prior knowledge of similar situations to determine the specific cause(s) of the problem.

LA023 Applies/Uses Study Habits/Methods Skimming/Scanning

- The technician will visually skim or scan the manufacturer's service manuals or databases to identify information that is related to any unfamiliar system under review, then study the applicable information with the intensity necessary for the situation.

LA035 Attends Directions/Task

- The technician attends to all written and oral directions that relate to the task or system under study.

LA036 Attends Nonverbal Cues

- The technician attends to nonverbal cues in discussions with customers and associates to verify, identify, and solve problems.

LA037 Attends Verbal Cues

- The technician attends to verbal cues in discussions with customers and associates to verify, identify, and solve problems.

LA038 Collects/Organizes Information-Oral/Written
- The technician collects and organizes oral and written information based on discussions, notes, observations, personal experiences, and data collection that will assist in the problem analysis and solution process.

LA069 Composes/Edits Notes
- The technician makes notes regarding symptoms, possible causes of problems, and other data that will aid in the diagnosis and problem solving process.

LA074 Composes/Edits Paragraphs
- The technician composes complete and accurate paragraphs that include information regarding symptoms, diagnosis results, and appropriate details when preparing warranty claims and information for inclusion on work orders.

LA098 Composes/Edits Reports Summaries
- The technician uses appropriate grammar and sentence structure when summarizing problems and actions taken in reports.

LA099 Composes/Edits Sentences
- The technician uses conventional sentence structure, spelling, capitalization, and punctuation when composing sentences for warranty reports.

LA121 Comprehends Information-Oral
- The technician can comprehend information gathered during discussions with customers, supervisors, and associates regarding problem symptoms and potential solutions.

LA132 Comprehends Information-Written
- The technician can comprehend and apply available written information needed to diagnose, analyze, and solve problems.

LA134 Comprehends Information-Written Cause/Effect Relationships
- The technician comprehends and uses cause and effect relationships presented in service manual problem solving trees to diagnose faults in a component or system.

LA136 Comprehends Information-Written Charts/Tables/Graphs
- The technician consults charts, tables, or graphs to determine the manufacturer's specifications for component or system alignment.

LA147 Comprehends Information-Written Sequence
- The technician consults written information to determine the applicable technical sequence required for solving a specific problem.

LA167. Evaluates Information-Oral
- The technician can evaluate the usefulness of oral information provided by customers or associates when analyzing a problem.

LA180 Evaluates Information-Written
- The technician evaluates the usefulness of available written information for clarity and adequacy when analyzing a problem.

LA215 Identifies Information-Written Abbreviations/Acronyms
- The technician can identify and use written abbreviations and acronyms in diagnosis and problem solving.

LA231 Identifies Purpose/Strategy Listening/Reading/Speaking/Writing
- The technician identifies both purpose and effective strategies for listening, reading, speaking, and writing when dealing with customers, associates, and supervisors.

LA236 Infers/Predicts Information-Oral
- The technician makes inferences and recommends solutions to problems based on discussions with customers, associates and supervisors.

LA247 Infers/Predicts Information-Written
- The technician makes inferences and predicts the solution to the problem from the information provided on the work order.

LA266 Presents Informal Speech Information Requests
- The technician requests specific information relative to the symptoms of the problem from the customer, and possible solutions to the problem from associates and supervisors.

LA267 Presents Informal Speech Information Supplying
- The technician supplies clarifying information to customers, associates, the parts supplier, and the supervisor.

LA271 Uses Dictionary
-The technician refers to the dictionary to define terms or to check spelling.

LA278 Uses Text Resources
- The technician uses text resources such as glossaries of terms, service manual indexes, database menus, and tables of contents to gather data for diagnosis and repair.

LA283 Uses Media Resources Databases
- The technician uses computerized and other databases to obtain system information.

LA285 Comprehends Information-Written Operator's Manual
- The technician can comprehend and apply information in the operator's manuals to operate and maintain automotive and autobody tools and equipment.

LA286 Uses Text Resources Service (Shop) Manual
- The technician uses the service manual, in both database and hard copy formats, to identify the manufacturer's specifications for system operation, component specifications, and formulas for mixing various compounds.

## MATH SKILLS

MA026 Computes Addition Decimals
- The technician can add numbers that include decimals to determine conformance with the manufacturer's specifications.

MA028 Computes Addition Mentally
- The technician can mentally add two or more numbers to determine conformance with the manufacturer's specifications.

MA034 Computes Addition Whole Numbers
- The technician can add whole numbers to accurately determine measurement conformance with the manufacturer's specifications.

MA039 Computes Division Decimals
- The technician can divide decimals to determine measurement conformance with the manufacturer's specifications.

MA047 Computes Division Whole Numbers
- The technician can divide whole numbers to determine differences for comparison with the manufacturer's specifications.

MA065 Computes Multiplication Decimals
- The technician can multiply numbers that include decimals to determine conformance with the manufacturer's specifications.

MA067 Computes Multiplication Mentally
- The technician can mentally multiply numbers that include decimals to determine conformance with the manufacturer's specifications.

MA073 Computes Subtraction Whole Numbers
- The technician can subtract whole numbers to determine differences for comparison with the manufacturer's specifications.

MA084 Computes Subtraction Decimals
- The technician can subtract numbers that include decimals to determine conformance with the manufacturer's specifications.

MA086 Computes Subtraction Mentally
- The technician can mentally subtract numbers to arrive at a difference for comparison with the manufacturer's specifications.

MA092 Computes Subtraction Whole Numbers
- The technician can subtract whole numbers to determine differences for comparison with the manufacturer's specifications.

MA126 Converts Units English/Metric -- Feet/Meters, e.g.
- The technician can measure/test with tools designed for English or metric measurements and then convert the resulting measurement to the system used by the manufacturers for specifying the correct measurement or tolerance.

MA153 Formulates/Verifies Angles
- The technician can visually formulate and verify the angle of the spray pattern or spray equipment.

MA161 Identifies English Measures Length/Volume/Weight
- The technician can determine the degree of conformance to the manufacturer's specifications for length, volume and any other appropriate measurements in the English system.

MA171 Identifies Metric Measures Length/Volume/Weight
- The technician can determine the degree of conformance to the manufacturer's specifications for length, volume and other appropriate measurements using the metric system.

MA174 Interprets Charts/Tables/Graphs
- The technician can interpret charts, tables, or graphs to determine the manufacturer's specifications for a given system.

MA176 Interprets Symbols <, >, =, e.g.
- The technician interprets symbols to determine compliance with the manufacturer's specifications.

MA177 Interprets System of Numbers Place Value
- The technician is able to interpret place value (tenths, hundredths, thousandths) when conducting precision measurements.

MA181 Measures Direct Distance
- The technician can measure distance using a variety of devices to determine conformance to the manufacturer's tolerances and specifications.

MA182 Measures Direct Temperature
- The technician can use appropriate temperature measurement tools to determine the existing temperature of ambient air and that of paints and inhibitors.

MA183 Measures Direct Time
- The technician needs to measure time which is very critical to proper mixing, application, and drying of certain finishes and substances.

MA186 Measures Indirect
- The technician can use various forms of indirect measurement to determine if components are in conformance with manufacturer's specifications.

MA190 Measures Metric Distance
- The technician can use metric measurement instruments to determine correct sizes or distances in the metric system.

MA191 Measures Metric Temperature
- The technician can use metric temperature measurement instruments to determine ambient air temperature and that of paints and inhibitors.

MA192 Measures Metric Volume
- The technician can determine the volume of a vessel when the specifications are in liters.

MA193 Measures Metric Weight
- The technician can use metric weighing devices to determine the conformance of a weight to metric tolerances.

MA242 Understands Definitions Standards
- The technician can use and conform to standards defined by each manufacturer for the system being analyzed.

| | | | |
|---|---|---|---|
| MA271 | Determines | Proper Operation | |

- The technician can determine the proper sequence of arithmetic operations to arrive at a solution when comparing system measurements to the manufacturer's specifications.

| | | | |
|---|---|---|---|
| MA273 | Computes | Tolerances/Ranges | Mentally |

- When comparing the observed measurement to the manufacturer's specifications, the technician can mentally compute whether the observed measurement is out-of-tolerance.

| | | | |
|---|---|---|---|
| MA274 | Computes | Proper Operations | Mentally |

- The technician can determine the proper mathematical operation (addition, multiplication, subtraction or division) and mentally arrive at a solution.

| | | | |
|---|---|---|---|
| MA275 | Identifies | Temperatures | Fahrenheit/Centigrade |

- The technician can identify whether a temperature measurement should be made using a Fahrenheit or Centigrade measuring device.

## *SCIENCE SKILLS*

SC007 Analyzes/Evaluates Environmental Issues

- The technician develops and maintains an understanding of all federal, state, and local rules and regulations regarding environmental issues related to the work of the autobody technician. The technician uses such things as government impact statements, media information, and general knowledge of pollution and waste management to correctly use and dispose of products that result from the performance of a repair task.

SC012 Analyzes/Evaluates Environmental Issues Waste Management

- The technician evaluates the waste products resulting from an automobile body repair task and handles the disposal of materials in accordance with applicable federal, state, and local rules and regulations.

SC041 Applies/Uses Laboratory Techniques Safety

- The technician follows all safety regulations and applicable procedures while performing the task.

SC042 Applies/Uses Maps/Charts/Tables/Graphs

- The technician uses the information in service manual charts, tables, or graphs to determine the manufacturer's specifications for components and the appropriate repair/replacement procedure and/or part.

SC044 Applies/Uses Scientific Methods

- The technician develops a theory relative to the cause of the problem based on the information provided, then tests the hypothesis to determine the solution. Major steps include: ① identify the problem; ② gather information; ③ develop hypothesis; ④ take action; ⑤ check results.

SC052 Converts Measurement Units English/Metric

- The technician can convert measurements taken in the English or metric system to specifications stated in terms of either system.

SC114 Describes/Explains Chemical Reactions

- The technician can demonstrate an understanding of the chemical reaction that occurs in various substances used in the automobile.

SC116 Describes/Explains Chemical Reactions Catalysts

- The technician can explain the role a catalyst plays in the mixing of fillers or finishes for use on the automobile body.

SC121 Describes/Explains Chemical Reactions Inhibitors

- The technician can explain the purpose of adding additives to an autobody repair compound.

SC127 Describes/Explains Pigmentation/Color

- The technician can describe and explain the role that pigmentation plays in determining the specific shade of an automobile body or interior color.

SC130 Describes/Explains Color Spectrum

- The technician demonstrates an understanding of the total spectrum of color by explaining the roles different colors play in a mixture.

SC212 Describes/Explains Electrochemical Reactions Activity of Metals

- The technician can explain the conductivity problems in a circuit when connectors corrode due to electrochemical reactions.

SC213 Describes/Explains Electrochemical Reactions Oxidation/Reduction

- The technician can explain the effect of oxidation on electrical connections as well as on an automotive finish.

SC219 Describes/Explains Electromagnetism Magnets
- The technician can explain how attaching magnets to an automobile body can cause paint to be evenly distributed through the principles of magnetism.

SC255 Describes/Explains Force Pressure
- The technician can demonstrate an understanding of the concept of pressure in relation to the concept of force.

SC274 Describes/Explains Heat Conduction/Convection
- The technician is able to explain the concept of heat transfer in terms of conduction, radiation, and convection in various automotive systems.

SC277 Describes/Explains Heat Expansion/Contraction
- The technician is able to demonstrate an understanding of the expansion and contraction of various system parts as a result of heat generated during the use and cooling of the system when not in operation.

SC278 Describes/Explains Heat Fusion/Vaporization
- The technician can demonstrate an understanding of the effect of how adding heat causes a change in state of matter, such as from a solid to a liquid to a gas.

SC282 Describes/Explains Heat Temperature
- The technician can explain the differences between heat and temperature and demonstrate an understanding of how to measure each.

SC321 Describes/Explains Light Angle of Incidence/Reflection
- The technician can explain how the angle or amount of light can impact on the appearance of a given finish in terms of texture and quality of finish.

SC329 Describes/Explains Light Opaque
-The technician can explain color and shades of color based on how light hits it.

SC335 Describes/Explains Light Translucent/Transparent
- The technician can explain the difference between the principles of translucent light (diffuses) as contrasted to transparent light (passes through).

SC336 Describes/Explains Light Ultraviolet
- The technician can explain how ultraviolet rays can cause a finish or substance to deteriorate.

SC341 Describes/Explains Matter Phases/States
- The technician can explain in detail the three states of matter.

SC355 Describes/Explains Motion Velocity
- The technician can explain how the velocity of an object in motion impacts on another object.

SC395 Describes/Explains Solutions Solvent
- The technician understands the use and safety requirements of all solvents used in an autobody environment.

SC443 Describes/Explains Weather/Climate Relative Humidity
- The technician can demonstrate an understanding of and discuss relative humidity in terms of effect on paint and substance applications.

SC467 Identifies Definitions Operational
- The technician is able to identify and define terms that specifically relate to systems, diagnosis, service, and repair.

SC489 Measures Distance/Length
- The technician uses precision measuring devices to determine if wear and adjustments are within the manufacturer's specifications, and to assure that replacement parts meet the manufacturer's specifications.

SC493 Measures Mass/Weight
- The technician uses a scale to measure component weight in order to mix an adhesive or to determine the strength and integrity of a component or part.

SC494 Measures Pressure
- The technician uses pressure measuring tools to determine pressures in hydraulic or pneumatic paint systems and compares them to the manufacturer's specifications.

SC495 Measures Temperature Fahrenheit/Centigrade
- The technician uses direct and indirect methods to measure system temperatures and then converts them to Fahrenheit or Centigrade as required by the manufacturer for proper cure and application times.

SC496 Measures Time
- The technician uses direct and indirect methods to measure application times, mixing guidelines for certain products, and labor time guides for selected tasks.

SC497 Measures Volume Liquids/Solids
- The technician uses direct and indirect methods to measure the volume of liquids in a mixture for adhesion purposes.

SC499 Uses Computers Information Processing
- The technician uses computer databases for information retrieval and for input devices to process information for customers, billing purposes, warranty work, and other record-keeping purposes.

SC504 Describes/Explains Fluid System Pneumatics
- The technician can demonstrate an understanding of the physical properties in pneumatic systems, tools and equipment.

SC508 Describes/Explains Matter Metallurgy
- The technician can explain the criticality of metals with different hardness, depending on the function and location of the metal as well as how fillers and finishes adhere to metal.

SC510 Describes/Explains Fluid System Dynamics
- The technician can explain the dynamic control properties of a hydraulic system in terms of its impact on spray patterns, volume, etc.

SC511 Describes/Explains Matter Surface Process (Absorption/Adsorption)
- The technician can explain the surface process that occurs on system seals due to absorption of the contained materials.

SC512 Describes/Explains Chemical Reactions Contamination
- The technician can demonstrate an understanding of how a contaminated liquid can cause a chemical reaction which can result in the deterioration of the finish or a plastic component.

SC520 Measures Flow Rate
- The technician can use precision gauges or instruments to measure the flow rate of air in a painting application.

SC521 Describes/Explains Flow Rate
- The technician can demonstrate an understanding of how variances in flow rate can effect the spray patterns, thickness of coat, etc., in the finishing process.

SC522 Applies/Uses Ratio Proportion Mixtures
- The technician can correctly use proportions and ratios in mixing fillers, finishes, and other substances.

SC527 Describes/Explains Acids/Bases/pH
- The technician can explain the role that acids and bases have in altering compounds used on or in the automobile.

SC528 Describes/Explains Adhesives/Sealants
- The technician can demonstrate an understanding of how surface processes and cohesive/adhesive forces aid in glues, tapes, and sealants.

SC529 Identifies Physical Properties Glass/Polymers
- The technician can identify and use proper service procedures based on the physical properties of an automobile component or system that are made of glass or plastic.

SC530 Describes/Explains Chemical Reactions Activators
- The technician can describe or explain the role that activators have in causing a change in the chemical state of a compound or filler.

SC531 Describes/Explains Viscosity
- The technician can explain fluid viscosity as a measurement and why it is important to the application of fillers, plastics, and finishes.

SC532 Describes/Explains Light Source
- The technician can accurately locate and explain the properties of a given source of light.

# COLLISION REPAIR & REFINISH TASK LIST

## TASK LIST INFORMATION

The NATEF task list was reviewed and updated in 1993 with funding from a grant awarded by the U.S. Department of Education. In February 1993, a national committee was assembled in Herndon, Virginia to review the standards used in the Collision Repair & Refinish certification program. The committee consisted of individuals representing the major automobile manufacturers, collision repair & refinish repair shop owners and technicians, collision repair & refinish instructors, autobody equipment and parts suppliers, Inter-Industry Conference on Auto Collision Repair (I-CAR), and state Technical and Industrial education supervisors. The committee reviewed the Standards, task list, tools and equipment list, program hours, and instructor qualifications. The committee also had, for their reference, the most current (September, 1992) National Institute for Automotive Service Excellence (ASE) task list. The ASE task list was developed with the expertise of a similar panel of technical service experts. The ASE task list is used to develop the ASE certification examination, a nationally recognized symbol of competence in diagnosing and repairing vehicle problems.

The NATEF Collision Repair & Refinish committee recommended that the "High Priority" tasks have an additional designation based on demonstration of competency. **High Priority - Group (HP-G) is defined as a task that can be taught in a group setting (2 or more students) through the use of video, demonstration, etc. Students should be tested on the information presented, but are not required to demonstrate competency on an individual basis. High Priority - Individual (HP-I) is defined as a task that requires students to demonstrate competency to the instructor on an individual basis.**

**Certified programs must include 95% of the HP-I tasks and 90% of the HP-G tasks in the curriculum.** Tasks not designated as HP-I and HP-G are additional tasks that may be included in the curriculum. Competency in HP-I tasks will indicate to employers that the graduate is skilled in that area. HP-G tasks will indicate to employers that the graduate has been tested on the information, but may not have "hands-on" competency skills.

# Assumptions

1. In all areas appropriate theory, safety, and support instruction will be required for performing each task. It is assumed that this has included identification and use of appropriate tools and testing and measuring equipment required to accomplish certain tasks. It is also assumed that the student has received the necessary training to locate and use current reference and training materials from accepted industry publications (in most cases published by the vehicle manufacturers). These publications present manufacturers' recommended or required specifications and procedures for performing various tasks.

2. The individual training program being evaluated for certification should have written and detailed performance standards for each task taught in the curriculum. The learning progress of students should be monitored and evaluated against these performance standards. A system should be in place which informs all students of their individual progress through all phases of the training program.

3. It is recognized that individual courses of study will differ across autobody technician training programs. The development of appropriate learning delivery systems and tests which monitor student progress will be the responsibility of the individual training program.

4. NATEF standards require that 95% of the HP-I tasks and 90% of the HP-G tasks be included in the instructional program and curriculum to satisfy certification standards. For additional information, review the section entitled, "Task List Information".

# NATEF TASK LIST

## I. STRUCTURAL ANALYSIS AND DAMAGE REPAIR

### A. Frame Inspection and Repair

| | | |
|---|---|---|
| 1. | Comply with personal and environmental safety practices associated with clothing, eye protection, use of chemicals, hand tools, and power equipment. | HP-I |
| 2. | Diagnose and measure structural damage using tram, centering, and datum guages according to industry specifications. | HP-I |
| 3. | Attach frame anchoring devices. | HP-G |
| 4. | Straighten and align mash (collapse) damage. | HP-G |
| 5. | Straighten and align sag damage. | HP-G |
| 6. | Straighten and align sidesway damage. | HP-G |
| 7. | Straighten and align twist damage. | |
| 8. | Straighten and align diamond frame damage. | |
| 9. | Remove and replace damaged frame horns, side rails, cross members, and front or rear sections. | |
| 10. | Restore corrosion protection to repaired or replaced frame areas. | HP-G |
| 11. | Repair or replace weakened or cracked frame members in accordance with vehicle manufacturers' recommendations/industry standards. | HP-G |
| 12. | Identify misaligned or damaged steering, suspension, and power train components which can cause vibration, steering, and wheel alignment problems; align or replace in accordance with vehicle manufacturers' recommendations. | |

# I. STRUCTURAL ANALYSIS AND DAMAGE REPAIR

## B. Unibody Inspection, Measurement, and Repair

**NOTE:** Recognize that measuring, dimensioning, and tolerance limits in unibody vehicles are critical to repair of these vehicles; recognize that suspension/steering mounting points and engine power train attaching points are critical to vehicle handling, performance, and safety.

1. Comply with personal and environmental safety practices associated with clothing, eye protection, use of chemicals, hand tools, and power equipment. HP-I
2. Identify misaligned or damaged steering, suspension, and power train components which can cause vibration, steering, and 4-wheel alignment problems; realign or replace in accordance with vehicle manufacturers' recommendations. HP-G
3. Diagnose and analyze unibody vehicle center line misalignment using centering guages. HP-I
4. Diagnose and analyze unibody vehicle length and width using a tram guage. HP-I
5. Diagnose and analyze unibody vehicle height using datum line guages. HP-I
6. Determine the locations of all suspension, steering, and power train component attaching points on the body. HP-G
7. Diagnose and measure unibody vehicles using a dedicated (fixture) measuring system.
8. Diagnose and measure unibody vehicles using a universal measuring system (mechanical, electronic, laser). HP-G
9. Determine the extent of the direct and indirect damage and the direction of impact; plan the methods and sequence of repair. HP-I
10. Attach body anchoring devices. HP-G
11. Straighten and align cowl assembly.

12. Straighten and align roof rails (headers) and roof panels.

13. Straighten and align hinge and lock pillars. HP-G

14. Straighten and align body openings, floor pans, and rocker panels. HP-G

15. Straighten and align quarter panels, wheelhouse assemblies, and rear body sections (including rails, suspension, and power train mounting points).

16. Straighten and align front end sections (aprons, strut towers, upper and lower rails, steering, suspension, and power train mounting points, etc.). HP-G

17. Use proper heat stress relief methods in high strength steel. HP-G

18. Use proper cold stress relief methods. HP-G

19. Remove folds, curves, creases, and dents using power tools and hand tools to restore damaged areas to proper contours and dimensions. HP-I

20. Determine the extent of damage to structural steel body panels, repair or replace. HP-I

21. Remove and replace damaged sections of structural steel body panels in accordance with manufacturers' specifications. HP-G

22. Restore corrosion protection to repaired or replaced unibody structural areas. HP-I

## I. STRUCTURAL ANALYSIS AND DAMAGE REPAIR

### C. Fixed Glass

1. Comply with personal and environmental safety practices associated with clothing, eye protection, use of chemicals, hand tools, and power equipment. HP-I

2. Remove and replace fixed glass (heated and non-heated) using manufacturers' recommendations. HP-G

3. Remove and replace modular glass using manufacturers' recommendations. HP-G

## I. STRUCTURAL ANALYSIS AND DAMAGE REPAIR

### D. Metal Welding and Cutting

1. Comply with personal and environmental safety practices associated with clothing, eye protection, use of chemicals, hand tools, and power equipment. HP-I
2. Identify weldable and non-weldable materials used in autobody components; understand the limitations of welding and cutting high-strength steels and other metals. HP-I
3. Determine correct welder type (MIG, resistance spot, oxy-acetylene, TIG), electrode, wire type, diameter, and gas to be used in specific welding situations. HP-I
4. Set up welding equipment. HP-I
5. Adjust the welder to "tune" for proper electrode stickout, voltage, polarity, flow rate, and wire-feed speed required for the material being welded. HP-I
6. Apply knowledge of the procedures for safely handling high-pressure gas cylinders. HP-G
7. Determine work clamp (ground) location and attach. HP-I
8. Use the proper angle of the gun to the joint and the direction of the gun travel for the type of weld being made in the flat, horizontal, vertical, and overhead positions. HP-I
9. Protect adjacent panels, glass, vehicle interior, etc. from welding and cutting operations. HP-G
10. Protect computers and other electronic control modules from possible weld damage. HP-G
11. Clean the metal to be welded; assure good metal fit-up through preparation and clamping; apply weld-through primer. HP-I
12. Determine the joint type (butt, lap, etc.) for weld being made. HP-I

13. Determine the type of weld (continuous, stitch/pulse, tack, plug, etc.) for each specific welding operation. HP-I

14. Perform continuous, stitch/pulse, tack, plug, spot weld (on butt and lap joints); perform destructive tests. HP-I

15. Identify the causes of spits and sputters, burn through, lack of penetration, cracks in metal, porosity, incomplete fusion, excessive spatter, distortion, and waviness of bead; make necessary adjustments. HP-I

16. Identify cause of contact tip burn-back and failure of wire to feed; make necessary adjustments. HP-I

17. Identify cutting process for different materials and locations in accordance with manufacturers' recommendations; perform cutting operation. HP-I

## II. NON-STRUCTURAL ANALYSIS AND DAMAGE REPAIR

### A. Preparation

1. Comply with personal and environmental safety practices associated with clothing, eye protection, use of chemicals, hand tools, and power equipment. HP-I

2. Review damage report and analyze damage to determine appropriate methods for overall repair; develop repair plan. HP-G

3. Remove and replace exterior trim and moldings. HP-I

4. Remove and replace interior trim and components. HP-I

5. Remove and replace non-structural body panels and components that may interfere with or be damaged during repair. HP-I

6. Remove and replace all vehicle mechanical and electrical components that may interfere with or be damaged during repair. HP-G

7. Protect panels and parts adjacent to repair area. HP-I

8. Remove dirt, grease, and wax from those areas to be repaired. HP-I

9. Remove corrosion protection, undercoatings, sealers, and other protective coatings necessary to perform repairs. HP-I

10. Remove and replace repairable plastics and other components that are recommended for off-vehicle repair.

11. Apply safety and environmental practices associated with vehicle components and systems, i.e. ABS, air bags, refrigerants, etc. HP-G

## II. NON-STRUCTURAL ANALYSIS AND DAMAGE REPAIR

### B. Outer Body Panel Repairs, Replacements, and Adjustments

1. Comply with personal and environmental safety practices associated with clothing, eye protection, use of chemicals, hand tools, and power equipment. HP-I

2. Determine the extent of direct and indirect damage and direction of impact; develop repair plan. HP-G

3. Remove and replace bolted, bonded, and welded steel panel or panel assemblies. HP-I

4. Determine the extent of damage to aluminum body panels; repair, weld or replace in accordance with manufacturers' specifications.

5. Remove, replace, and align hood, hood hinges, and hood latch. HP-I

6. Remove, replace, and align deck lid, lid hinges, and lid latch. HP-I

7. Remove, replace, and align doors, tailgates, hatches, lift gates, latches, hinges, and related hardware. HP-I

8. Remove, replace, and align bumper bars, covers, reinforcement guards, isolators, and mounting hardware. HP-I

9. Check and align front fenders, headers, and other panels. HP-I

10. Straighten and rough-out contours of damaged panel to a surface condition for body filling or metal finishing using power tools, hand tools, and stud welder. HP-I

11. Weld cracked or torn steel body panels; repair broken welds. HP-I

12. Restore corrosion protection. HP-I

13. Braze body panels only in locations recommended by vehicle manufacturers.

14. Cut out damaged sections of sheet steel body panels and weld in replacements according to vehicle and industry specifications. HP-I

15. Replace door skins. HP-I

16. Replace intrusion beams in accordance with vehicle manufacturers' specifications. HP-G

17. Replace or repair rigid, semi-rigid, and flexible plastic panels according to vehicle and industry specifications.

18. Restore sealers, mastic, sound deadeners, and foam fillers. HP-I

19. Diagnose and repair water leaks, dust leaks, and wind noise. HP-G

## II. NON-STRUCTURAL ANALYSIS AND DAMAGE REPAIR

### C. Metal Finishing and Body Filling

1. Comply with personal and environmental safety practices associated with clothing, eye protection, use of chemicals, hand tools, and power equipment. HP-I

2. Remove paint from the damaged area of a body panel. HP-I

3. Pick, file, and disc sand the damaged area of a body panel to locate and reduce surface irregularities. HP-I

4. Demonstrate hammer and dolly techniques. HP-I

5. Heat shrink stretched panel areas to proper contour.

6. Cold shrink stretched panel areas to proper contour.

7. Mix body filler. HP-I

8. Apply body filler; cheese-grate during curing. HP-I

9. Rough sand cured body filler to contour; finish sand. HP-I

## II. NON-STRUCTURAL ANALYSIS AND DAMAGE REPAIR

### D. Moveable Glass and Hardware

1. Comply with personal and environmental safety practices associated with clothing, eye protection, use of chemicals, hand tools, and power equipment. HP-I

2. Inspect, adjust, repair or replace window regulators, run channels, glass, power mechanisms, and related controls. HP-I

3. Repair or replace power-driven accessories and related controls (including electrically-heated glass).

4. Diagnose and repair water leaks, dust leaks, and wind noises; inspect, repair, and replace weatherstripping. HP-G

5. Inspect, repair or replace, and adjust removable, manually or power operated roof panel and hinges, latches, guides, handles, retainer, and controls of sun roofs.

6. Remove, reinstall, and align convertible top and related mechanisms.

## II. NON-STRUCTURAL ANALYSIS AND DAMAGE REPAIR

### E. Metal Welding and Cutting

1. Comply with personal and environmental safety practices associated with clothing, eye protection, use of chemicals, hand tools, and power equipment. HP-I

2. Identify weldable and non-weldable materials used in autobody components; understand the limitations of welding and cutting high-strength steels and other metals. HP-I

3. Determine correct welder type (MIG, resistance spot, oxy-acetylene, TIG), electrode, wire type, diameter, and gas to be used in specific welding situations. HP-I

4. Set up welding equipment. HP-I

5. Adjust the welder to "tune" for proper electrode stickout, voltage, polarity, flow rate, and wire-feed speed required for the material being welded. HP-I

6. Apply knowledge of the procedures for safely handling high-pressure gas cylinders. HP-G

7. Determine work clamp (ground) location and attach. HP-I

8. Use the proper angle of the gun to the joint and the direction of the gun travel for the type of weld being made in the flat, horizontal, vertical, and overhead positions. HP-I

9. Protect adjacent panels, glass, vehicle interior, etc. from welding and cutting operations. HP-G

10. Protect computers and other electronic control modules from possible weld damage. HP-G

11. Clean the metal to be welded; assure good metal fit-up through preparation and clamping; apply weld-through primer. HP-I

12. Determine the joint type (butt, lap, etc.) for weld being made. HP-I

13. Determine the type of weld (continuous, stitch/pulse, tack, plug, etc.) for each specific welding operation. HP-I

14. Perform continuous, stitch/pulse, tack, plug, spot weld (on butt and lap joints); perform destructive tests. HP-I

15. Identify the causes of spits and sputters, burn through, lack of penetration, cracks in metal, porosity, incomplete fusion, excessive spatter, distortion, and waviness of bead; make necessary adjustments. HP-I

16. Identify cause of contact tip burn-back and failure of wire to feed; make necessary adjustments. HP-I

17. Identify cutting process for different materials and locations in accordance with manufacturers' recommendations; perform cutting operation. HP-I

## III. MECHANICAL AND ELECTRICAL COMPONENTS

### A. Suspension and Steering

1. Comply with personal and environmental safety practices associated with clothing, eye protection, use of chemicals, hand tools, and power equipment. HP-I

2. Identify suspension system fasteners which should not be reused. HP-G

3. Inspect and replace rack and pinion steering gear, inner tie rod ends, and bellows boots. HP-G

4. Inspect alignment, adjust tension, and replace power steering pump belts. HP-G

5. Remove and replace power steering pump; inspect pump mounts. HP-G

6. Inspect and replace power steering hoses and fittings. HP-G

7. Remove and replace power steering gear (non-rack and pinion type). HP-G

8. Remove and replace power rack and pinion steering gear; inspect and replace mounting bushings and brackets; ensure proper mounting location. HP-G

9. Inspect and adjust (where applicable) steering linkage geometry (attitude/parallelism). HP-G

10. Inspect and replace pitman arm. HP-G

11. Inspect and replace relay (center link/ intermediate) rod. HP-G

12. Remove and replace idler arm and mountings. HP-G

13. Remove and replace tie rod sleeves, clamps, and tie rod ends. HP-G

14. Remove and replace steering linkage damper. HP-G

15. Remove and replace upper and lower control arms. HP-G

16. Remove and replace upper and lower control arm bushings, shafts and rebound bumpers. HP-G

17. Remove and replace upper and lower ball joints. HP-G

18. Remove and replace steering knuckle/spindle/hub assemblies. HP-G

19. Remove and replace front suspension system coil springs and spring insulators (silencers). HP-G

20. Inspect, replace, adjust front suspension system torsion bars, and inspect mounts. HP-G

21. Inspect and replace stabilizer bar bushings, brackets, and links. HP-G

22. Inspect and replace MacPherson strut cartridge or assembly, upper bearing, and mount. HP-G

23. Remove and replace rear suspension system coil springs and spring insulators (silencers). HP-G

24. Inspect, remove, and replace rear suspension system transverse links, control arms, stabilizer bars, bushings, and mounts. HP-G

25. Inspect, remove, and replace rear suspension system leaf spring(s), leaf spring insulators (silencers), shackles, brackets, bushings, and mounts. HP-G

26. Inspect rear axle assembly for damage and misalignment. HP-G

27. Inspect and replace shock absorbers. HP-G

28. Inspect and replace air shock absorbers, load-leveling devices, air springs, and associated lines and fittings. HP-G

| | | |
|---|---|---|
| 29. | Diagnose, inspect, adjust, repair or replace components of electronically-controlled suspension systems. | HP-G |
| 30. | Measure vehicle ride height; determine needed repairs. | HP-I |
| 31. | Remove, replace, and align front and rear frame (cradles/stub). | HP-G |
| 32. | Diagnose steering column damage, looseness, and binding problems (including tilt mechanisms); determine needed repairs. | HP-G |
| 33. | Diagnose manual steering gear (non-rack and pinion type) noises, binding, uneven turning effort, looseness, hard steering, and lubricant leakage problems; determine needed repairs. | HP-G |
| 34. | Diagnose manual rack and pinion steering gear noises, vibration, looseness, and hard steering problems; ensure proper mounting location. | HP-G |
| 35. | Inspect and replace steering shaft U-joint(s), flexible coupling(s), collapsible columns, and steering wheels. | HP-I |
| 36. | Diagnose power steering gear (non-rack and pinion type) noises, binding, uneven turning effort, looseness, hard steering, and fluid leakage problems; determine needed repairs. | HP-G |
| 37. | Diagnose power rack and pinion steering gear noises, vibration, looseness, hard steering, and fluid leakage problems; determine needed repairs. | HP-G |
| 38. | Diagnose non-MacPherson front and rear suspension system noises and body sway problems; determine needed repairs. | HP-G |
| 39. | Diagnose MacPherson strut suspension system noises and body sway problems; determine needed repairs. | HP-G |
| 40. | Diagnose vehicle wandering, pulling, hard steering, bump steering, memory steering, torque steering, and steering return problems; determine needed repairs. | HP-G |

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|---|---|
| 41. Check and adjust front and rear wheel camber on suspension systems with camber adjustments. | HP-I |
| 42. Check front and rear wheel camber on non-adjustable suspension system; determine needed repairs. | HP-I |
| 43. Check and adjust caster on suspension systems with caster adjustments. | HP-I |
| 44. Check caster on non-adjustable suspension systems; determine needed repairs. | HP-I |
| 45. Check and adjust front wheel toe. | HP-I |
| 46. Center steering wheel. | HP-I |
| 47. Identify toe-out-on-turns (turning radius) related problems; determine needed repairs. | HP-I |
| 48. Identify SAI (steering axis inclination)/KPI (king pin inclination) related problems; determine needed repairs. | HP-I |
| 49. Check rear wheel toe; determine needed repairs. | HP-I |
| 50. Identify thrust angle related problems; determine needed repairs. | HP-I |
| 51. Check for front wheel setback; determine needed repairs. | HP-I |
| 52. Diagnose tire wear patterns; determine needed repairs. | HP-I |
| 53. Inspect tires, identify direction of rotation, and location; check and adjust air pressure. | HP-I |
| 54. Diagnose wheel/tire vibration, shimmy, and tramp (wheel hop) problems; determine needed repairs. | HP-I |
| 55. Measure wheel, tire, axle, and hub runout; determine needed repairs. | HP-I |
| 56. Diagnose tire pull (lead) problems; determine corrective actions. | HP-I |
| 57. Reinstall wheels and torque lug nuts. | HP-I |

## III. MECHANICAL AND ELECTRICAL COMPONENTS

### B. Electrical

1. Comply with personal and environmental safety practices associated with clothing, eye protection, use of chemicals, hand tools, and power equipment. HP-I
2. Check voltages in electrical wiring circuits with a DMM (digital multimeter). HP-I
3. Check continuity and resistance in electrical wiring circuits and components with a DMM (digital multimeter). HP-I
4. Check electrical circuits, wiring, and connectors; repair according to manufacturers' specifications. HP-I
5. Inspect, test and replace fusible links, circuit breakers, and fuses. HP-I
6. Perform battery state-of-charge test; determine needed service. HP-I
7. Inspect, clean, and replace battery. HP-I
8. Perform slow/fast battery charge in accordance with manufacturers' recommendations. HP-I
9. Identify programmable electrical/electronic components; record data for reprogramming before disconnecting battery. HP-G
10. Inspect, clean, and repair or replace battery cables, connectors, and clamps. HP-I
11. Inspect alignment, adjust, and replace alternator driver belts, pulleys, and fans. HP-I
12. Remove and replace alternator. HP-G
13. Remove and replace headlights, parking/taillights, stoplights, flashers, turn-signals, and backup lights; check operation. HP-I
14. Inspect, replace, and aim headlights/bulbs. HP-I
15. Check operation of retractable headlight assembly. HP-I

16. Remove and replace motors, switches, relays, connectors, and wires of retractable headlight assembly circuits. HP-G

17. Inspect, test and repair or replace switches, relays, bulbs, sockets, connectors, and wires of all light circuits including four-wire taillight systems. HP-G

18. Remove and replace horn(s); check operation. HP-G

19. Check operation of windshield wiper/washer system. HP-I

20. Check operation of power side windows and power tail-gate window. HP-I

21. Remove and replace power seat, motors, linkages, cables, etc.; check operation. HP-G

22. Remove and replace components of electric door and hatch/trunk lock; check operation. HP-I

23. Remove and replace components of keyless lock/unlock devices and alarm systems; check operation. HP-G

24. Remove and replace components of electrical sunroof and convertible top; check operation.

25. Check operation of electrically heated mirrors, windshields, back lights, panels, etc.; repair as necessary. HP-G

26. Remove and replace components of power antenna circuits; check operation.

## III. MECHANICAL AND ELECTRICAL COMPONENTS

### C. Brakes

1. Comply with personal and environmental safety practices associated with clothing, eye protection, use of chemicals, hand tools, and power equipment. HP-I

2. Inspect brake lines and fittings for leaks, dents, kinks, rust, cracks or wear; tighten loose fittings and supports; replace brake lines (double flare and ISO types), hoses, fittings, and supports. HP-I

3. Inspect flexible brake hoses for leaks, kinks, cracks, bulging or wear; remove and replace hoses; tighten loose fittings and supports. HP-I

4. Select, handle, store, and install brake fluids; dispose of per EPA regulations. HP-I

5. Bleed (manual, pressure, vacuum or surge) and/or flush hydraulic brake system in accordance with manufacturers' procedures. HP-I

6. Pressure test brake hydraulic system; determine needed repair. HP-G

7. Adjust brake shoes; remove and reinstall brake drums or drum/hub assemblies and wheel bearings. HP-I

8. Reinstall wheel and torque lug nuts. HP-I

9. Remove and reinstall caliper assembly. HP-I

10. Clean and inspect caliper mountings and slides for wear and damage. HP-G

11. Check parking brake system operation. HP-I

12. Identify and replace ABS wheel speed sensor components according to manufacturers' specifications. HP-G

13. Depressurize ABS hydraulic system according to manufacturers' specifications. HP-G

## III. MECHANICAL AND ELECTRICAL COMPONENTS

### D. Heating and Air Conditioning

1. Comply with personal and environmental safety practices associated with clothing, eye protection, use of chemicals, hand tools and power equipment. HP-I

2. Identify and comply with environmental concerns relating to CFCs. HP-G

3. Maintain and verify correct operation of certified refrigerant recovery and recharging equipment. HP-G

4. Locate and identify A/C system service parts. HP-G

5. Identify and recover refrigerant from A/C system. HP-G

| | | |
|---|---|---|
| 6. | Recycle refrigerant in accordance with EPA regulations. | HP-G |
| 7. | Label and store refrigerant. | HP-G |
| 8. | Test recycled refrigerant for non-condensable gases. | HP-G |
| 9. | Evacuate A/C system; check for leaks. | HP-G |
| 10. | Recharge A/C system with refrigerant (liquid or vapor); perform leak test. | HP-G |
| 11. | Identify oil type and maintain correct amount in A/C system according to manufacturers' specifications. | HP-G |
| 12. | Inspect, adjust, and replace A/C compressor drive belts; check pulley alignment. | HP-G |
| 13. | Remove and replace A/C compressor; inspect, repair or replace A/C compressor mountings. | HP-G |
| 14. | Inspect, repair or replace A/C system mufflers, hoses, lines, fittings, and seals. | HP-G |
| 15. | Inspect A/C condenser for air flow restrictions; clean and straighten fins. | HP-G |
| 16. | Inspect, test, and replace A/C system condenser and mountings. | HP-I |
| 17. | Inspect and replace receiver/drier or accumulator/drier. | HP-G |
| 18. | Inspect and replace evaporator. | HP-G |
| 19. | Inspect and repair evaporator housing water drain. | HP-G |
| 20. | Inspect, test, repair or replace heating, ventilating, and A/C vacuum components. | HP-G |
| 21. | Inspect and repair A/C component wiring. | HP-G |
| 22. | Inspect, test, and repair heating, ventilating and A/C ducts, doors, hoses, and outlets. | HP-G |

## III. MECHANICAL AND ELECTRICAL COMPONENTS

### E. Cooling Systems

1. Comply with personal and environmental safety practices associated with clothing, eye protection, use of chemicals, hand tools, and power equipment. HP-I
2. Inspect and replace engine cooling and heater system hoses and belts. HP-I
3. Inspect, remove and replace radiator, pressure cap, coolant recovery system, and water pump. HP-G
4. Remove and replace thermostat, by-pass, and housing.
5. Recover, refill, and bleed system with proper coolant and check level of protection; leak test system and dispose of materials in accordance with EPA specifications. HP-I
6. Remove and replace fan (both electrical and mechanical), fan pulley, fan clutch, and fan shroud. HP-G
7. Inspect, remove, and replace auxiliary oil coolers; check oil levels. HP-G
8. Inspect, remove, and replace electric fan sensors; check operation. HP-G

## III. MECHANICAL AND ELECTRICAL COMPONENTS

### F. Drive Train

1. Comply with personal and environmental safety practices associated with clothing, eye protection, use of chemicals, hand tools, and power equipment. HP-I
2. Remove, replace, and adjust shift or clutch linkage as required. HP-G
3. Remove, replace, and adjust cables or linkages for throttle valve (TV), kickdown, and accelerator pedal. HP-G
4. Remove and replace electronic sensors, wires, and connectors. HP-G

5. Remove and replace powertrain assembly; inspect, replace, and align powertrain mounts. HP-G

6. Remove and replace front and/or rear drive axle assembly. HP-G

7. Measure and/or adjust half shaft position/angle. HP-G

8. Remove, inspect, and replace front-drive half shafts and axle constant velocity joints (CV). HP-G

9. Inspect, remove and replace front and rear drive shafts and universal joints. HP-G

## III. MECHANICAL AND ELECTRICAL COMPONENTS

### G. Fuel, Intake and Exhaust Systems

1. Comply with personal and environmental safety practices associated with clothing, eye protection, use of chemicals, hand tools, and power equipment. HP-I

2. Remove, inspect, and replace exhaust manifold, exhaust pipes, mufflers, converters, resonators, tail pipes, and heat shields. HP-G

3. Remove, inspect, and replace heat stove shroud, hot air pipe, and damper of inlet air temperature control systems. HP-G

4. Remove, inspect, and replace fuel tank, fuel tank filter, fuel cap, fuel filler hose, quarter to body seal, and inertia stitch; inspect and replace fuel lines and hoses; check fuel for contaminants. HP-G

5. Remove, inspect, and replace components of air injection systems.

6. Remove, inspect, and replace canister, filter, vent, and purge lines of fuel vapor control systems. HP-G

## III. MECHANICAL AND ELECTRICAL COMPONENTS

### H. Restraint Systems

#### 1. Active Restraint Systems

| | |
|---|---|
| 1. Comply with personal and environmental safety practices associated with clothing, eye protection, use of chemicals, hand tools, and power equipment. | HP-I |
| 2. Inspect, remove, and replace seatbelt and shoulder harness assembly and components in accordance with manufacturers' recommendations. | HP-I |
| 3. Inspect restraint system mounting areas for damage; repair in accordance with manufacturers' recommendations. | HP-I |
| 4. Verify proper operation of seatbelt in accordance with manufacturers' recommendations. | HP-I |

#### 2. Passive Restraint Systems

| | |
|---|---|
| 1. Comply with personal and environmental safety practices associated with clothing, eye protection, use of chemicals, hand tools, and power equipment. | HP-I |
| 2. Remove and replace seatbelt and shoulder harness assembly and components in accordance with manufacturers' recommendations. | HP-G |
| 3. Inspect restraint system mounting areas for damage; repair as necessary. | HP-G |
| 4. Verify proper operation of seatbelt in accordance with manufacturers' recommendations. | HP-G |
| 5. Remove, inspect, and replace track and drive assembly, lap retractor, torso retractor, inboard buckle-lap retractor, and knee bolster (blocker) in accordance with manufacturers' recommendations. | HP-G |

#### 3. Supplemental Restraint Systems (SRS)

| | |
|---|---|
| 1. Comply with personal and environmental safety practices associated with clothing, eye protection, use of chemicals, hand tools, and power equipment. | HP-I |

2. Disarm SRS in accordance with manufacturers' procedures. HP-I
3. Inspect and replace sensors and wiring in accordance with manufacturers' procedures; ensure sensor orientation. HP-G
4. Inspect, replace, and dispose of deployed SRS modules in accordance with manufacturers' procedures. HP-G
5. Verify that SRS is armed and operational in accordance with manufacturers' procedures. HP-I
6. Inspect, remove, replace, and dispose of non-deployed SRS in accordance with manufacturers' procedures. HP-G
7. Use fault codes and test equipment to diagnose and repair SRS. HP-G

## IV. PLASTICS AND ADHESIVES

1. Comply with personal and environmental safety practices associated with clothing, eye protection, use of chemicals, hand tools, and power equipment. HP-I
2. Identify the types of plastics to be repaired. HP-I
3. Identify the types of plastics repair procedures; clean and prepare the surface of plastic parts in accordance with industry guidelines. HP-I
4. Repair plastic parts with hot-air welding.
5. Repair plastic parts with airless welding. HP-G
6. Repair plastic parts with urethane or epoxy adhesives; use reinforcements if necessary. HP-I
7. Repair holes and cuts in rigid and flexible plastic parts using backing materials and adhesives. HP-I
8. Retexture plastic parts.
9. Repair vinyl-clad urethane foam parts.
10. Remove damaged areas from rigid exterior SMC (sheet molded compound) panels; repair with partial panel. HP-G

11. Replace bonded SMC (sheet molded compound) body panels; straighten or align panel supports. HP-G

12. Prepare repaired areas for refinishing. HP-I

## V. PAINTING AND REFINISHING

### A. Safety Precautions

1. Comply with personal and environmental safety practices associated with clothing, eye protection, use of chemicals, hand tools, and power equipment. HP-I

2. Identify and take necessary precautions with hazardous operations and materials according to EPA, state, and local regulations. HP-I

3. Identify personal health and safety hazards according to OSHA guidelines and "Right to Know" Act. HP-I

4. Inspect spray environment for cleanliness and safety hazards. HP-I

5. Select approved respirator; inspect to ensure proper fit and operation; inspect the condition of the respirator filters and other components (to conform with local and state regulations). HP-I

### B. Surface Preparation

1. Comply with personal and environmental safety practices associated with clothing, eye protection, use of chemicals, hand tools, and power equipment. HP-I

2. Remove, assess, and store trim and moldings. HP-I

3. Remove dirt, road grime, wax or other protective coatings from the area to be refinished and adjacent vehicle surfaces; wash entire vehicle. HP-I

4. Inspect and identify substrate, type of finish and surface condition; develop a plan for refinishing using a total products system. HP-I

5. Remove paint finish. HP-G

6. Dry or wet sand areas to be refinished. HP-I

7. Featheredge broken areas to be refinished. HP-I

8. Identify type of metal and apply suitable metal treatment or primer. HP-I

9. Mask trim and protect other areas that will not be refinished. HP-I

10. Mix primer, primer-surfacer or primer-sealer; spray onto surface of repaired area. HP-I

11. Apply two-component putty to minor surface imperfections. HP-I

12. Dry or wet sand area to which primer-surfacer and/or two-component putty have been applied. HP-I

13. Remove dust from area to be refinished, including cracks or moldings of adjacent areas. HP-I

14. Clean area to be refinished using a final cleaning solution. HP-I

15. Remove, with a tack rag, any dust or lint particles from the area to be refinished. HP-I

16. Apply suitable sealer to the area being refinished when sealing is needed or desirable. HP-I

17. Scuff sand to remove nibs or overspray from a sealer. HP-I

18. Apply stone chip-resistant coating. HP-G

19. Restore corrosion-resistant coatings, caulking, and seam sealers to repaired areas. HP-G

20. Prepare adjacent panels for blending. HP-I

## V. PAINTING AND REFINISHING

### C. Spray Gun and Related Equipment Operation

1. Comply with personal and environmental safety practices associated with clothing, eye protection, use of chemicals, hand tools, and power equipment. HP-I

2. Inspect, clean, and determine condition and adequacy of spray guns and related equipment (air hoses, regulators, air lines, air source, and spray environment). HP-I

3. Check and adjust spray gun pressure for siphon-feed, pressure-feed, gravity-feed, HVLP (high volume, low pressure) or LVLP (low volume, low pressure) guns. HP-I

4. Adjust spray gun using fluid, air, and pattern control valves. HP-I

## V. PAINTING AND REFINISHING

### D. Paint Mixing, Matching, and Applying

1. Comply with personal and environmental safety practices associated with clothing, eye protection, use of chemicals, hand tools, and power equipment. HP-I

2. Determine type and color of paint already on vehicle. HP-I

3. Shake, stir, reduce, catalyze, and strain paint according to manufacturers' recommendations. HP-I

4. Use appropriate spray technique (gun arc, gun angle, gun distance, gun speed, and spray pattern overlap) for finish being applied. HP-I

5. Apply selected product on test panel in accordance with manufacturers' recommendations; check for color match. HP-I

6. Apply single stage topcoat for panel blending or overall refinishing. HP-I

7. Apply basecoat/clearcoat for spot and panel blending or overall refinishing. HP-I

8. Color sand, buff, and polish finishes where necessary. HP-I

9. Identify the types of rigid, semi-rigid or flexible plastic parts to be refinished; determine the materials and refinishing procedures. HP-G

10. Refinish rigid, semi-rigid or flexible plastic parts. HP-I

11. Clean, condition or refinish vinyl (e.g. upholstery, dashes, and tops). HP-I

12. Apply multi-stage (mica, pearl, etc.) coats for spot repair, panel blending or overall refinishing. HP-G

13. Identify and mix paint formula. HP-G

14. Tint color using formula to achieve a blendable match. HP-G

## V. PAINTING AND REFINISHING

### E. Solving Paint Application Problems

1. Comply with personal and environmental safety practices associated with clothing, eye protection, use of chemicals, hand tools, and power equipment. HP-I

2. Identify blistering (raising of the paint surface); determine the cause(s) and correct the condition. HP-G

3. Identify blushing (milky or hazy formation); determine the cause(s) and correct the condition. HP-G

4. Identify crazing in the paint surface; determine the cause(s) and correct the condition. HP-G

5. Identify contaminants in the painted surface; determine the source(s) and correct the condition. HP-G

6. Identify a dry spray appearance in the paint surface; determine the cause(s) and correct the condition. HP-G

7. Identify the presence of fish-eyes (crater-like openings) in the finish; determine the cause(s) and correct the condition. HP-G

8. Identify lifting (surface distortion or shriveling) while the topcoat is being applied; determine the cause(s) and correct the condition. HP-G

9. Identify mottling or streaking in metallic and mica paint finishes; determine the cause(s) and correct the condition. HP-G

10. Identify orange peel; determine the cause(s) and correct the condition. HP-G

11. Identify an overspray; determine the cause(s) and correct the condition. HP-G

12. Identify solvent popping (pin-holing) in freshly painted surface; determine the cause(s) and correct the condition. HP-G

13. Identify sags and runs in paint surface; determine the cause(s) and correct the condition. HP-G

14. Identify sandscratch swelling; determine the cause(s) and correct the condition. HP-G

15. Identify shrinking and splitting while finish is drying; determine the cause(s) and correct the condition. HP-G

16. Identify color that is off-shade; determine the cause(s) and correct the condition. HP-G

17. Identify tape tracking; determine the cause(s) and correct the condition. HP-G

18. Identify loss of gloss; determine the cause(s) and correct the condition. HP-G

## V. PAINTING AND REFINISHING

### F. Finish Defects, Causes, and Cures

1. Comply with personal and environmental safety practices associated with clothing, eye protection, use of chemicals, hand tools, and power equipment. HP-I

2. Identify poor adhesion; determine the cause(s) and correct the condition. HP-G

3. Identify paint cracking (crowsfeet or line-checking, micro-checking, etc.); determine the cause(s) and correct the condition. HP-G

4. Identify rust spots; determine the cause(s) and correct the condition. HP-G

5. Identify blistering in the paint surface; determine the cause(s) and correct the condition. HP-G

6. Identify water spotting; correct the condition. HP-G
7. Identify finish damage caused by bird droppings, tree sap, and other natural causes; correct the condition. HP-G
8. Identify finish damage caused by airborne contaminants (acids, soot, and other industrial-related causes); correct the condition. HP-G
9. Identify die-back conditions (dulling of the paint film showing haziness); correct the condition. HP-G
10. Identify chalking (oxidation); correct the condition. HP-G
11. Identify body filler bleed-through (staining); correct the condition. HP-G
12. Identify solvent popping (pin-holing); correct the condition. HP-G
13. Identify buffing-related imperfections (swirl marks, wheel burns); correct the condition. HP-I

## V. PAINTING AND REFINISHING

### G. Final Detail

1. Comply with personal and environmental safety practices associated with clothing, eye protection, use of chemicals, hand tools, and power equipment. HP-I
2. Apply decals, transfers, tapes, woodgrains, pinstripes (painted and taped), etc. HP-G
3. Buff and polish finish as required. HP-I
4. Clean interior, exterior, and glass. HP-I
5. Clean body openings (door jams & edges, etc.). HP-I
6. Remove overspray. HP-I

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